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ABSTRACT

This volume on "Scientists and Inventors" was created to appeal to young readers in a format they can enjoy reading and can readily understand. Each volume contains alphabetically arranged sketches of outstanding people. Each entry provides at least one picture of the individual profiled, and bold-faced rubrics lead the reader to information on birth, youth, early memories, education, first jobs, marriage and family, career highlights, memorable experiences, hobbies, and honors and awards. Each of the entries ends with a list of easily accessible sources designed to lead the student to further reading on the individual and a current address. Obituary entries are also include in the volume, written to provide a perspective on the individual's entire career. Obituaries are clearly marked in both the table of contents and at the beginning of the entry. Entries in Volume 6 are: Hazel Barton (1971-); Alexa Canady (1950-); Arthur Caplan (1950-); Francis Collins (1950-); Gertrude Elion (Retrospective) (1918-1999); Henry Heimlich (1920-); David Ho (1952-); Kenneth Kamler (1947-); Lucy Spelman (1963-); and Lydia Villa-Komaroff (1947-). (Contains a general index, a place of birth index, and a birthday index.) (BT)

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Biography Today: Profiles of People of Interest to Young Readers. Scientists and Inventors Series, Volume 6.

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Vol. 6

Biography Today

Profiles of People of Interest to Young Readers

Scientists & Inventors Series

Medical leaders featured in this issue

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Biography Today

Profiles of People of Interest to Young Readers

Scientists & Inventors Series

Volume 6

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Preface

Welcome to the sixth volume of the **Biography Today Scientists and Inventors Series**. We are publishing this series in response to suggestions from our readers, who want more coverage of more people in *Biography Today*. Several volumes, covering **Artists, Authors, Scientists and Inventors, Sports Figures, and World Leaders,** have appeared thus far in the Subject Series. Each of these hardcover volumes is 200 pages in length and covers approximately 10 individuals of interest to readers ages 9 and above. The length and format of the entries are like those found in the regular issues of *Biography Today*, but there is **no duplication** between the regular series and the special subject volumes.

Volume 6 Devoted to Medical Leaders

It's an exciting time to be a scientist, particularly in the area of medicine—an incredibly diverse field that offers so many opportunities for our students. That's why this special volume in our **Biography Today Scientists and Inventors Series** focuses on leaders in the medical field. The individuals profiled here are considered trailblazers in their areas of expertise. For example, young students might enjoy reading about Alexa Canady, the first female African-American neurosurgeon in the United States; or Francis Collins, the geneticist who successfully mapped and sequenced human DNA; or David Ho, the pioneering AIDS researcher. Other students might be intrigued by Hazel Barton, the microbiologist who studies bacteria in extreme environments, like caves; or Kenneth Kamler, the doctor and mountain climber who takes care of fellow climbers on expeditions to Mount Everest; or Lucy Spelman, the veterinarian who is the director of the National Zoo. The life stories of these accomplished and inspiring individuals offer motivation and encouragement to students considering careers in the sciences—and to those who are simply interested in reading about these fascinating medical leaders.

The Plan of the Work

As with the regular issues of *Biography Today*, this special subject volume on **Scientists and Inventors** was especially created to appeal to young readers in a format they can enjoy reading and readily understand. Each volume contains alphabetically arranged sketches. Each entry provides at least one picture of the individual profiled, and bold-faced rubrics lead the reader to infor-

mation on birth, youth, early memories, education, first jobs, marriage and family, career highlights, memorable experiences, hobbies, and honors and awards. Each of the entries ends with a list of easily accessible sources designed to lead the student to further reading on the individual and a current address. Obituary entries are also included, written to provide a perspective on the individual's entire career. Obituaries are clearly marked in both the table of contents and at the beginning of the entry.

Biographies are prepared by Omnigraphics editors after extensive research, utilizing the most current materials available. Those sources that are generally available to students appear in the list of further reading at the end of the sketch.

Indexes

A new index now appears in all *Biography Today* publications. In an effort to make the index easier to use, we have combined the **Name** and **General Index** into one, called the **General Index**. This new index contains the names of all individuals who have appeared in *Biography Today* since the series began. The names appear in bold faced type, followed by the issue in which they appeared. The General Index also contains the occupations, nationalities, and ethnic and minority origins of individuals profiled. The General Index is cumulative, including references to all individuals who have appeared in the *Biography Today* General Series and the *Biography Today* Special Subject volumes since the series began in 1992.

The Birthday Index and Places of Birth Index will continue to appear in all Special Subject volumes.

Our Advisors

This series was reviewed by an Advisory Board comprised of librarians, children's literature specialists, and reading instructors to ensure that the concept of this publication—to provide a readable and accessible biographical magazine for young readers—was on target. They evaluated the title as it developed, and their suggestions have proved invaluable. Any errors, however, are ours alone. We'd like to list the Advisory Board members, and to thank them for their efforts.

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Our Advisory Board stressed to us that we should not shy away from controversial or unconventional people in our profiles, and we have tried to follow their advice. The Advisory Board also mentioned that the sketches might be useful in reluctant reader and adult literacy programs, and we would value any comments librarians might have about the suitability of our magazine for those purposes.

Your Comments Are Welcome

Our goal is to be accurate and up-to-date, to give young readers information they can learn from and enjoy. Now we want to know what you think. Take a look at this issue of *Biography Today*, on approval. Write or call me with your comments. We want to provide an excellent source of biographical information for young people. Let us know how you think we're doing.

Cherie Abbey
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Hazel Barton 1971-

British Microbiologist and Speleologist
Co-Star of the 2001 IMAX Film *Journey into Amazing Caves*

BIRTH

Hazel A. Barton was born in Bristol, England, on August 12, 1971. Her father, Derek Barton, was a grocery store manager, and her mother, Elaine Barton, was a retail clerk. She has an older sister, Helen, and a younger brother, Michael.

YOUTH

Barton grew up in a suburb of Bristol called Brislington Village. She was a tomboy who enjoyed exploring the area around her

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> *A classroom science project when she was 11 years old first got Barton hooked on science. "My project was to go to a nearby pond, fish out a pot of goo, bring it back to the classroom, and look at it under the microscope. . . ."*

home. "At the back of our house was an abandoned warehouse and a small wood through which a stream flowed," she recalled. "It was great—I spent every second of my summers out playing there, getting dirty, climbing trees, getting into trouble."

Barton was interested in science at an early age. But she was not always interested in bacteria, the microscopic life forms that she studies in her career as a microbiologist. She recalled that she first learned about bacteria when she was six years old. "One day a children's television show I was watching mentioned that every time you drink a glass of water, you swallow all these tiny organisms called bacteria," she noted. "I was totally grossed out, because I imagined all these slimy worms and gooey, nasty-looking things in the water. I wouldn't have believed then that one day I would actually make my living studying bacteria."

As a teenager, Barton's interest in science was fueled by her summer job at a veterinary clinic. She loved working with animals, but she was also fascinated by the diseases that affected them. She decided that she wanted to learn what caused the diseases and how they could be treated or cured.

Barton took her first caving trip at the age of 14 as part of an outdoor skills course. "I had no idea what I was getting into when I signed up for the course during an Outward Bound trip in Wales," she recalled. "I just found that I was very comfortable in the cave. The darkness or not knowing what was ahead didn't bother me a bit. It's exciting, actually!" Before long, Barton was making weekly excursions into the wet and muddy caves of England and Wales. Her interest in speleology—the scientific study of caves—eventually grew to include cave exploration and mapping.

EDUCATION

Barton attended Brislington School in England. She credits one of her teachers, Martin Upson, with encouraging her interest in science. His class introduced her to the idea of an ecosystem—a community of plants and animals that interact with each other in ways that keep their environment

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healthy—when she was 11 years old. "My project was to go to a nearby pond, fish out a pot of goo, bring it back to the classroom, and look at it under the microscope," she recalled. "We then wrote a long report about the animals that lived in the pond, how they interacted with each other and with the ecosystem. I included drawings of the creatures I saw, their scientific names, and a description of their lifestyle. In the evenings I would diligently color in the drawings from class. I was hooked." Another teacher, Jim Moon, helped encourage her interest in caving. She took a caving course as a sports elective in high school and practiced her technique in the limestone caves of nearby hills.

After graduating from Brislington School in 1987, Barton went on to study microbiology at the University of the West of England. "The more I learned about how microorganisms, such as bacteria, can cause—and cure —diseases, the more fascinated I became with them," she noted. She earned a degree in applied biological sciences with first-class honors in 1993. Upon completing her undergraduate education, Barton decided to pursue a doctorate degree (Ph.D.) in the United States at the University of Colorado (UC) in Boulder. Her graduate research focused on *Pseudomonas*, a dangerous bacteria that can cause blindness and even death. She received her Ph.D. in microbiology in 1997.

CAREER HIGHLIGHTS

When Barton moved to the United States, she was thrilled to discover that Colorado was home to a large number of fellow cavers. In fact, she attended a caving club meeting within days of her arrival. During her years in graduate school, Barton became an active member of a caving organization called the National Speleological Society (NSS). She eventually became chair of the Denver "grotto," as the local groups are known, and then of the entire Rocky Mountain region of the NSS. She also earned recognition as one of the top cave cartographers (mapmakers) in the country.

"...We then wrote a long report about the animals that lived in the pond, how they interacted with each other and with the ecosystem. I included drawings of the creatures I saw, their scientific names, and a description of their lifestyle. In the evenings I would diligently color in the drawings from class. I was hooked."

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Studying Bacteria

Barton remained at the University of Colorado after completing her Ph.D. Her first job involved teaching molecular biology to surgeons at the UC Health Sciences Center. Two years later, Barton got her "dream job" as a research associate in environmental microbiology in the Department of Molecular, Cellular, and Developmental Biology at UC. She worked in the laboratory of Dr. Norman Pace, who is both a famous scientist and a famous caver. "I perform experiments that examine the DNA of bacteria," she explained. "I also study how bacteria get food and survive in different habitats. As a caver, I'm especially interested in bacteria found in underground environments."

> *"I work with a team of microbiologists who study microorganisms that live in extreme environments—places like caves. Organisms in these environments have to fight hard for precious resources, such as nutrients, without wasting precious energy. So these bacteria make lethal weapons against each other. Our hope is to isolate an organism with such a lethal weapon against something like tuberculosis or cancer. In other words, we're looking for antibiotics for the new millennium."*

The main focus of Barton's research is the bacterium that causes drug-resistant tuberculosis. Tuberculosis is a contagious disease that affects the lungs and other parts of the body, causing fever, weakness, and coughing. Tuberculosis was once very common, but doctors developed drugs called antibiotics to treat it. In recent years, however, the bacteria has become resistant to some types of antibiotics—in other words, the bacteria that used to be killed off by certain antibiotics is now immune. Drugs that were once effective in treating and curing the disease are now ineffective. "My research is aimed at studying multi-drug resistant tuberculosis (MDR-TB)," Barton noted. "This bacterium is becoming a new global health threat, especially in developing countries. There are only a few drugs remaining that are effective against this type of TB. A World Health Organization report recently stated that, if not handled correctly, MDR-TB could be equivalent to the emergence of HIV [human immunodeficiency virus, which causes AIDS], only spread like the common cold. Sixty to ninety million people are predicted to die by 2020. It's pretty scary."

Collecting and Studying Extremophiles

Part of Barton's job involves looking for previously unknown types of bacteria that might provide sources of new antibiotics to treat MDR-TB and other diseases. Her specialty is searching for microscopic organisms that exist in environments where other life forms cannot survive. Thanks to their ability to withstand extreme conditions, these bacteria are known as extremophiles. "I work with a team of microbiologists who study microorganisms that live in extreme environments—places like caves," Barton explained. "Organisms in these environments have to fight hard for precious resources, such as nutrients, without wasting precious energy. So these bacteria make lethal weapons against each other. Our hope is to isolate an organism with such a lethal weapon against something like tuberculosis or cancer. In other words, we're looking for antibiotics for the new millennium."

"This research [on extremophiles] has told us so much about the evolution of life on our planet (microbes have been around 3,700 times as long as we have—and were responsible for the nice oxygen atmosphere we breathe today). These results can therefore tell us about where we might expect to find life elsewhere in our solar system. . . . After all, if microorganisms can live deep inside a glacier on Earth, then perhaps they can also survive under the frozen surface of Europa, one of Jupiter's moons, or in the polar ice caps of Mars."

Barton and her fellow scientists have found extremophiles in a variety of hostile climates around the world. For example, they have collected samples from volcanic vents located two miles below the surface of the Pacific Ocean, from the boiling water in the hot springs at Yellowstone National Park, from mine drainages where the water contains enough acid to burn through clothing, and from caves where no light has ever penetrated. In the process of this research, they have discovered whole new kingdoms of microorganisms. Kingdoms are very broad scientific classifications, such as plants and animals. "As different as you (from the animal kingdom) are from a cabbage (from the plant kingdom)," Barton stated, "we have found 12 kingdoms of microbes just as different from everything else known!"

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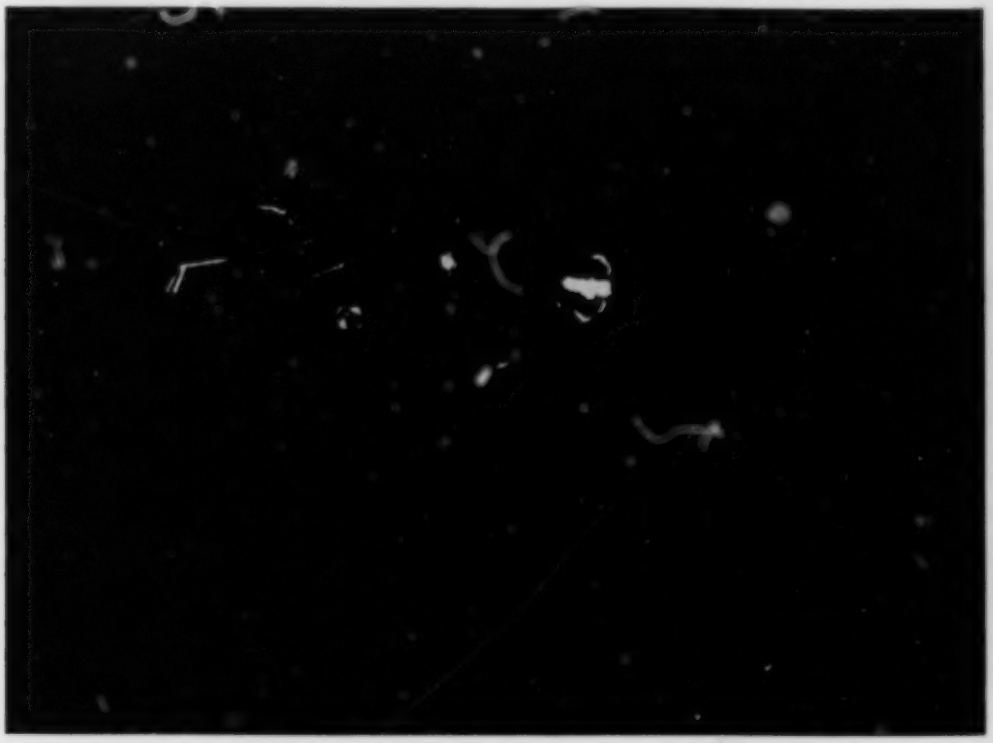
Once she collects new "bugs" from caves, Barton takes them back to her lab to study their DNA. She then tries to figure out what types of food and conditions they like in order to grow them in cultures. Finally, she studies their properties in order to see whether they might provide a source for new antibiotics. Studying extremophiles takes a great deal of time. In fact, it can take Barton six months in the lab to process the samples from a week-long trip. "This is the beginning of a long road," she admitted. "This is science that's only just begun to happen. Work that's been going on in extremophiles is a very new field. We didn't even know six years ago that organisms could live in these environments the way they do. Then, take that one step further and apply it to medical research, it takes several more years."

In addition to its applications in medical research, the study of extremophiles may also provide clues about the history of life on Earth and elsewhere. "This research has told us so much about the evolution of life on our planet (microbes have been around 3,700 times as long as we have—and were responsible for the nice oxygen atmosphere we breathe today)," Barton noted. "These results can therefore tell us about where we might expect to find life elsewhere in our solar system. . . . After all, if microorganisms can live deep inside a glacier on Earth, then perhaps they can also survive under the frozen surface of Europa, one of Jupiter's moons, or in the polar ice caps of Mars."

Appearing in the IMAX Film *Journey into Amazing Caves*

In 1998, Barton learned that MacGillivray Freeman Films was planning to make an IMAX film about caves. IMAX is a filmmaking process that uses special film and lighting to record images on a very large scale without a loss of clarity. IMAX films are usually shown on huge, curved screens that cover the entire walls and ceiling of the theater. Viewers enjoy the films because they provide a physical sensation of being in the middle of the action. MacGillivray Freeman Films is one of the premier IMAX filmmaking companies. It gained international acclaim for its feature film *Everest*, based on the May 1996 disaster that took the lives of five climbers on Mt. Everest. (For more information on the 1996 disaster, see entries on Kenneth Kamler in this volume of *Biography Today Scientists and Inventors* and on Jon Krakauer in *Biography Today Authors*, Vol. 6.)

Barton first heard about the upcoming IMAX movie when the filmmakers contacted one of her caver friends and asked him to send in an audition videotape. Several months later, MacGillivray Freeman Films got in touch with Barton and asked her for a videotape. "They had a certain profile,"



she recalled. "Obviously, they wanted a caver who was capable of going to these environments. They wanted someone under 30 because they wanted this person to appeal to kids. They didn't want a crusty old 45-year-old. And they wanted Ph.D. level scientists. Well, there aren't too many Ph.D. level scientists under 30 who can do this caving, so when you look around the country there really was only me."

In August 1998, Barton learned that she had been selected to co-star in the IMAX film *Journey into Amazing Caves.* The filmmakers went through 1,000 audition videos and finally narrowed their choices down to two women: Barton and Nancy Holler Aulenbach, a Montessori school teacher from Atlanta, Georgia. Aulenbach had been caving with her family since childhood and developed a deep passion for it. She specialized in mapping caves, studying their geology, and performing cave rescues. The filmmakers had trouble choosing between the two women, so they decided to use both. They felt that Barton would provide an interesting scientific component to the film, while Aulenbach would help viewers form an emotional connection to caves.

Both Barton and Aulenbach had a few reservations about starring in *Journey into Amazing Caves.* Like many cavers, they worried about their sport

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becoming too popular. After all, caves are fragile environments that can be severely damaged by human impact. They also did not want to encourage untrained thrill-seekers to put themselves in danger by going caving. "Nobody really truly wanted the movie to be made," Barton admitted, "but it was going to be made anyway."

In the end, Barton decided that educating people about caves was the best way to promote conservation. "My greatest hope is that people will understand more about the beauty and uniqueness of the underground environment. Too many people consider caves to be just a big hole in the ground and a convenient place to dump trash, dead cows, or whatever. Unfortunately, we cavers are to blame for that. We've long considered secrecy as a means of conservation, but what happens is that people are ignorant of the resource," she noted. "Without educating the public as to why and how caves should be protected, we can never protect what little resource there is."

In making the IMAX film **Journey into Amazing Caves**, *Barton says, "My greatest hope is that people will understand more about the beauty and uniqueness of the underground environment. Too many people consider caves to be just a big hole in the ground and a convenient place to dump trash, dead cows, or whatever. Unfortunately, we cavers are to blame for that. We've long considered secrecy as a means of conservation, but what happens is that people are ignorant of the resource. Without educating the public as to why and how caves should be protected, we can never protect what little resource there is."*

Visiting Three Different Amazing Caves

The film *Journey into Amazing Caves* took Barton and Aulenbach to three exotic locations to visit three different types of caves. When the filming began, the two stars did not know each other. They were both NSS members and had attended conventions together, but they had never really talked. They met on a flight to Greenland to shoot scenes for the film, and they were good friends by the time they arrived. "Nancy and I are complete opposites—she's fairly conservative, while I thrive on being outrageous," Barton noted. "But because of a

shared passion for caves and caving, despite our differences, we became instant best friends."

Greenland, located in the North Atlantic Ocean off the east coast of Canada, is the largest island in the world. Most of its area is north of the Arctic Circle and covered with ice. Barton and Aulenbach went there to visit an ice cave inside a glacier. These caves form when rivers of meltwater flow through faults in the glacier, carving holes in the flowing ice. They spent two weeks camped on the ice, where temperatures reached 25 degrees below zero (Fahrenheit) and winds gusted at 100 miles per hour. They slept in four sleeping bags tucked inside each other and still struggled to keep warm. "In those kinds of conditions, being in a tent with someone you don't like can be a horrific experience," Barton commented. The two women had to learn to use ice axes and crampons (sharp metal spikes attached to boots to prevent slipping on ice). They also had to relearn their traditional caving techniques to accommodate their thick clothing and gloves.

"The ice caves of Greenland were completely unexpected in their beauty. When I thought about ice caves, I thought, 'Hmmm . . . just a hole in the ice.' The reality were these incredible cathedrals of ice, which shone with an iridescent blue from filtered sunlight. Those caves were among the most breathtaking things I've ever seen."

Despite the rugged conditions, Barton was impressed by the glowing blue caverns in the glacial ice. "The ice caves of Greenland were completely unexpected in their beauty. When I thought about ice caves, I thought, 'Hmmm . . . just a hole in the ice.' The reality were these incredible cathedrals of ice, which shone with an iridescent blue from filtered sunlight. Those caves were among the most breathtaking things I've ever seen." Barton also used the opportunity to collect ice samples that were over 200 years old in order to examine them for extremophiles.

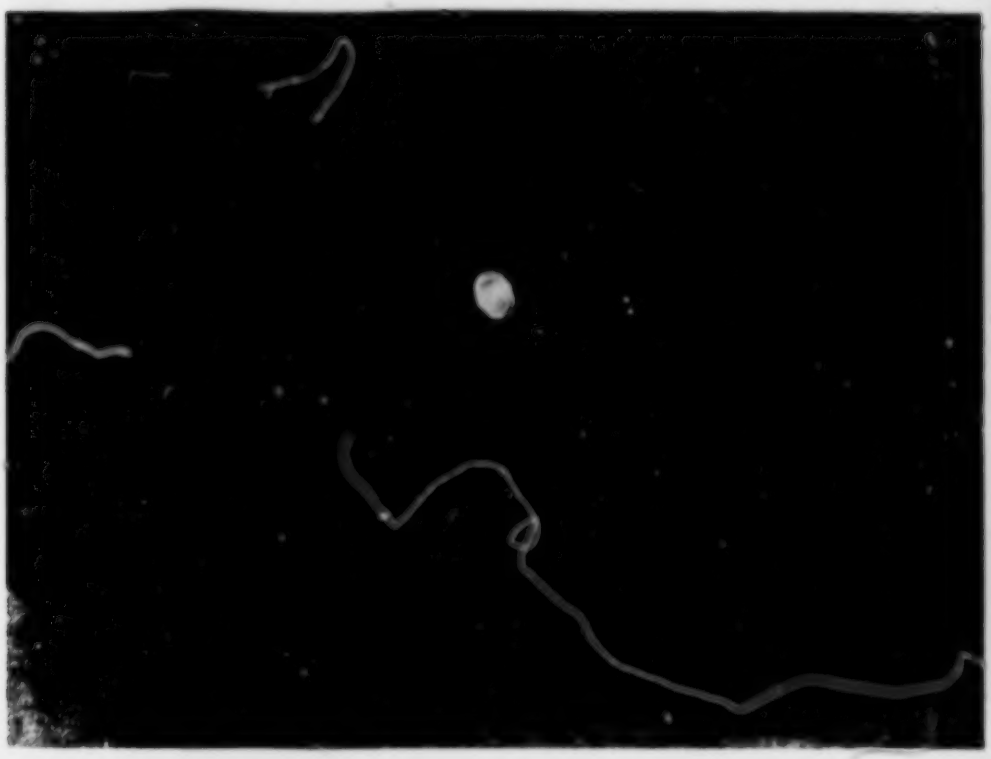
In another part of *Journey into Amazing Caves*, Barton and Aulenbach visited a limestone cave in Little Rock Canyon in Arizona. The cave is located high in a canyon wall, 800 feet above the Little Colorado River. The two women had to rappel (use a rope to lower themselves) 300 feet down from the top of the cliff and then swing into the cave entrance. Although she enjoyed seeing the previously unexplored cave, Barton has said that

this was her least favorite part of shooting the movie. "I'm scared of heights—which is why I'm a caver!" she stated. "You can only see as far as your headlamp, and mine is pretty dim. In Arizona we had to rappel off of an 800 foot high cliff, and I could see all the way to the bottom. It was a bit unnerving."

The third location featured in the film was near Tulum on the Yucatan peninsula of Mexico. Barton and Aulenbach visited Dos Ojos, the third-largest underwater cave in the world. In order to explore underwater caves, cavers must wear scuba-diving equipment. Cave diving requires special training and skills and can be very dangerous. Divers can easily kick up silt and get lost or run out of oxygen. In fact, 400 people have died in the short history of cave diving as a sport. Aulenbach decided not to take part in the underwater exploration, but Barton felt that the experience would be worth it. "After some serious soul searching, I decided it was worth the risk," she explained. "The caver in me wanted to see an underwater cave's legendary beauty for myself, and the scientist in me couldn't resist the research potential. It seemed to me I might find microorganisms not found anywhere else."

Barton's goal in this portion of the film was to take samples of the halocline—an unusual layer that forms where saltwater from the ocean meets freshwater from inland springs and rivers. The halocline looks like the shimmering surface of a lake even though it is already underwater. Since it is a rare environment, Barton hoped to find previously unknown extremophiles there. The location in Mexico turned out to be Barton's favorite part of making *Journey into Amazing Caves*. She enjoyed learning cave diving techniques and exploring underwater, although it did have some negative aspects. "It felt like an all-expenses paid vacation to go cave diving with my friends," she noted. "It was a lot of work, though; some days I'd wear my wetsuit for up to 14 hours! I developed quite an interesting rash."The underwater scenes were also quite difficult for the film crew to capture. "There were actually nine of us in the water down there when we were filming," Barton recalled. "You see me swimming toward the camera. What you don't see are seven people with lights swimming backwards as fast as they can."

Journey into Amazing Caves was released in 2001 to positive reviews. Robert K. Elder of the *Chicago Tribune* called it "an adventurous, educational, and stunningly beautiful film," adding that it "holds an impressive power over its audience—making us gasp, sigh, and sit in silent awe of nature." Writing in the *Atlanta Journal and Constitution*, Bob Longino noted that the movie was "entertaining enough for young kids to not only enjoy but just



maybe absorb a little knowledge." At the same time as the film was released, the National Geographic Society published a companion book called *Exploring Caves: Journeys into the Earth*. Illustrated with photos from the movie, the book also includes commentary by Barton and Aulenbach about cave formation, exploration, and mapping, as well as information about cave-dwelling creatures.

Sharing Her Love of Caving and Science

Being involved with the IMAX film has provided Barton with a unique opportunity to share her love of both caving and science with young people. "I got involved in this because it's a great opportunity for me to go to environments that I couldn't justify on grant money. If they want to stick me in front of a camera to do that, that's fine. But I'm not Hollywood. I love doing my research but I certainly am not into the whole self-promotion thing," she explained. "I think the great thing about this movie is that it gives kids an opportunity to see that science can be a fairly interesting career. When I grew up, the image of scientists were as boring people who went about wearing protective goggles and white lab coats. Now we have kids coming up to us saying 'Wow! I want to be a scientist.'"

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Barton knows that *Journey into Amazing Caves* might encourage some people to try caving. But she says that caving is not for everyone, and that people should have a realistic picture of the discomforts and risks involved. "Caving is cold, wet, muddy, and difficult," she noted. "You wear your oldest, scruffiest clothes and no one can see you doing it. Because of this, it doesn't appeal to the 'Mountain Dew' generation the same way that say mountain biking or kayaking have. I don't think it's on the verge of becoming the next big 'sport.' Most of the viewers of the movie come away with the sense that a cave is the last place on Earth they'd like to be."

For people who remain interested in caving, Barton suggests that they begin by going on a guided cave tour. The next step is to learn about caving skills through an organization like NSS. But Barton emphasizes that caving can be dangerous for people without proper training and preparation. "Are you ready to grab a flashlight and head underground? Stop right where you are!" she wrote in *Exploring Caves*. "Although caving can be an amazing adventure, it can also be dangerous, even deadly, especially for inexperienced cavers. That's why you should NEVER enter a cave unless you are with an experienced adult caver."

"Are you ready to grab a flashlight and head underground? Stop right where you are!" Barton wrote in Exploring Caves. *"Although caving can be an amazing adventure, it can also be dangerous, even deadly, especially for inexperienced cavers. That's why you should NEVER enter a cave unless you are with an experienced adult caver."*

Barton admits that she has come close to serious injury or death on a few occasions due to the unpredictable things that can happen in caves. For example, she once barely avoided falling into an 80-foot-deep pit when the ledge she was standing on gave way. The experience made her think carefully about her reasons for caving. "I had to deal with the fact, 'OK, why are you doing this? What is it you are gaining from your life by going into this environment and doing these things?" she recalled. "And then I realized: I've been caving for a long time. I love the environment. I love the people. I love the places you get to go . . . the benefits to everybody in understanding the biology and the hydrology and the life in these caves. I could stop doing it because of the risks, but I'd give something up about me by doing that, and that I couldn't accept."

"My aim when traveling around science theaters is to instill in kids just how much fun science can be. Just like caving, each day is a new exploration, and you never know what you'll find. The analogy I use is Christmas Eve. It's the best part of Christmas, because you never know what presents you'll get, it's the anticipation of the surprise that's so exciting. And that is how a career in science feels."

In addition to talking about caving, Barton tells fans of the film about her passion for science. "My aim when traveling around science theaters is to instill in kids just how much fun science can be," she stated. "Just like caving, each day is a new exploration, and you never know what you'll find. The analogy I use is Christmas Eve. It's the best part of Christmas, because you never know what presents you'll get, it's the anticipation of the surprise that's so exciting. And that is how a career in science feels."

MARRIAGE AND FAMILY

Barton married Jim Olsen, a computer programmer, in October 2001. Their wedding took place inside a cave at Glenwood Caverns in Colorado. Barton's friend and movie co-star Nancy Aulenbach was a bridesmaid and wore pink caving gear. Barton and her husband do not have children.

WRITINGS

Exploring Caves: Journeys into the Earth, 2001 (with Nancy Holler Aulenbach and Marfe Feguson Delano)

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Minneapolis Star Tribune, June 13, 2001, p.B4
Oregonian, Apr. 4, 2001, p.B2
Pittsburgh Post-Gazette, Apr. 4, 2001, p.W1
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Alexa Canady 1950-

American Pediatric Neurosurgeon
First Female African-American Neurosurgeon in the United States

BIRTH

Alexa Irene Canady was born on November 7, 1950, in Lansing, Michigan. Her father, Clinton Canady, Jr., was a dentist. Her mother, Elizabeth Hortense (Golden) Canady, was a homemaker when her kids were young and was active in the field of education. In addition to raising her children, she served as the national president of the Delta Sigma Theta Sorority, she was the first African-American elected to the Lansing Board

of Education, and she worked as a college administrator. Alexa Canady has one older brother, Clinton III, and two younger brothers, Alan and Mark, all of whom became lawyers.

YOUTH

Growing up in a household with two successful parents, Canady always felt pressure to succeed. Her parents stressed that she should set ambitious goals for herself, even though she was a young black woman at a time when prejudice against women and blacks was common. They pointed out that Canady's grandmother was a professor at Tennessee's Lane College, a rarity at the time. Her parents felt that a similar level of professional success was not only realistic for their daughter, but expected. "I came from a family where education was very important, and women had a history of being very bright and finishing school early," Canady noted. "My grandmother was teaching by the time she was 16, and my mother finished college when she was 19."

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Canady did not mind the pressure. In fact, she embraced it and was thankful for the way her family encouraged her to make the most of her talents. She remembered that her grandmother "always treated me like I was a person worth listening to, even when I was a little person not worth listening to." This attention helped Canady learn to think for herself. For example, she challenged gender roles in the household at an early age. Her father recalled that his daughter "told us if she had to wash dishes, so should her brothers. She broke a lot. Later we joked that she broke dishes on purpose."

EDUCATION

The Canady family lived in a predominantly white neighborhood, and Alexa and her brother Mark were the only African-American students at their elementary school. Racism was a fact of life. Even though Canady was an exceptional student, she learned at an early age that the color of her skin would sometimes make things difficult for her. "During the sec-

ond grade, I did so well on the California reading test that the teacher thought it was inappropriate for me to have done so well," she recalled. "She lied about what scores were mine, and ultimately she was fired." After this situation was cleared up, Canady had her IQ tested. She scored so well on the test that she was able to jump from second to fourth grade.

Canady's family was careful to make sure that her accelerated education was balanced with other things, including music, dance, art, and sports. Despite her activities, Canady found herself in the intelligent "out crowd" in junior high school. "The early 1960s was a good time for that," she related. "Some of our teachers were interested in our group and gave us credibility and support." During this time she developed a love for mathematics and decided to pursue it as a career once she went to college.

Canady continued to excel throughout high school. She completed her senior courses in her junior year and earned a National Achievement Scholarship. During her senior year, she attended calculus courses at a local junior college. She graduated from high school in 1967.

Hitting a Bump in the Road

After high school, Canady began to pursue a degree in mathematics at the University of Michigan in Ann Arbor. At first, she proved to be an excellent student. But as time went on, she realized that she did not have a burning desire to be a mathematician, and as a result her grades began to slip. "I had a crisis of confidence. I did OK, but I didn't like it as much as those guys like it," she said of the male mathematicians she was working with at the time.

Canady gave up on mathematics after her freshman year and suddenly found herself at a crossroads in regard to the direction her life would take. She stopped going to classes in the first semester of her sophomore year, but she still managed to do relatively well. The second semester was a disaster, though. Canady only attended 16 hours of classes, and as a result she was put on academic probation.

Canady's college career turned around when she began working for the campus newspaper, the *Michigan Daily*. The experience brought her back into the world of academic culture. A short time later, one of her brothers told her about a minority health careers program at the university that paid students to participate. Canady saw this not only as a potential career opportunity, but also as a chance to earn enough money to get a car. She immediately signed up for the course.

Choosing a New Direction

The move paid off. Canady soon found that she had a love for medicine, and she prospered under the guidance of instructors like the noted geneticist and pediatrician Art Bloom. She enrolled in science classes and began to prepare for medical school. Upon earning her bachelor of science degree (B.S.) in 1971, she was accepted into the University of Michigan Medical School. Canady had worried that her poor grades might sabotage her admission, but her high test scores and participation in extracurricular activities—like writing for the *Michigan Daily* and being a member of the debate team—made up for the slip in her grades.

When she first started medical school, Canady wanted to be an internist. But she soon settled on neurology after falling in love with the way the nervous system works. "It's so neat and logical and precise," she said. When she decided to specialize in neurosurgery—which was a new field for African-American women at that time—Canady finally felt that her life and career were on the right path. Surprisingly, her parents were apprehensive about her decision. "My parents were cool to the idea because they weren't sure if I could get into neurosurgery or if I could make a career of it because I was both a woman and an African-American," she recalled. "I shared their concerns, but I had to try." Canady remarked that, ultimately, "the decision to become what you do for a living is not an intellectual one. It's really a visceral [instinctive] decision. Some places you feel at home, and I feel at home with neurosurgery. I couldn't play it safe because that wasn't me."

Canady's parents were apprehensive about her decision to specialize in neurosurgery. "My parents were cool to the idea because they weren't sure if I could get into neurosurgery or if I could make a career of it because I was both a woman and an African-American. I shared their concerns, but I had to try."

During her years in medical school, Canady joined the Alpha Omega Alpha Honorary Medical Society. She also received several awards, including a citation from the American Medical Women's Association. She graduated from medical school with honors in 1975.

Canady continued her medical training as an intern at Connecticut's Yale-New Haven Hospital. She found the atmosphere there to be a bit more re-

laxed than her final years at Michigan. She applied for a residency at Yale when her internship ended, but the hospital was slow to tell her if she would get the position. In the meantime, she accepted a residency in the Department of Neurosurgery at the University of Minnesota. Canady thus became the first female African-American neurosurgeon in the United

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States. She eventually learned that she would have received the Yale position as well. "The Yale people thought I should have known [that they were going to accept me]," she noted. "In 1976, they didn't understand that no black woman in her right mind was going to turn down a genuine offer for a maybe."

CAREER HIGHLIGHTS

First Black Woman Neurosurgeon

From the beginning of her residency, Canady faced unique challenges because of her gender and race. For example, the dean of the medical school told her that she had been hired in order to fill quotas that required the university to hire a certain number of women and African-Americans. But she refused to let such negative comments break her spirit. Instead, she was thankful that the civil rights movement had afforded her opportunities that would have previously been unavailable. "When I got a residency in neurosurgery, I got it not because I'm smarter than somebody 40 years ago, but because the politics were such that they needed a black woman and I was qualified," she explained. "I had impeccable credentials coming out of medical school, but there was an undercurrent of, 'How can you, a black woman, have the audacity to want to do this? Don't you know that you've got a double whammy?' Well, I came along at a time when it offered them a double positive. They could fulfill the quotas and say, 'I finished women, I finished blacks, and all it took was one person instead of two.' So that became a positive for me." Later, Canady learned that the dean made such disparaging comments to all of the residents and that he just "wanted to know how we would respond to stress. He had nothing else to say, and after that we were great buddies."

Canady spent five years at the University of Minnesota. In 1981, she accepted a fellowship in pediatric neurosurgery at the University of Pennsylvania and Children's Hospital of Philadelphia. When she first arrived, Canady rubbed some people the wrong way. Her boss, Dr. Luis Schut, recalled that Canady was overly sensitive and had a chip on her shoulder "the size of a California redwood." But Schut counseled the young resident and soon set her straight. Canady was voted one of the top residents one year, which was a rare honor for a neurosurgeon. To this day, she credits Schut for much of her success and refers to him as "a father figure" and someone who was always willing to "share how it really worked." The feelings were obviously mutual. Schut said that Canady was "one of the best trainees I've ever had. The others complain because Alexa was my favorite. She's got guts."

During her residency at Children's Hospital of Philadelphia, Canady taught neurosurgery at the University of Pennsylvania College of Medicine. This career stop was short-lived, though, because Canady missed her family. Eager to return to Michigan, she accepted a position at Detroit's Henry Ford Hospital in 1982. This job allowed her to teach and perform neurosurgery.

When Canady began working at Children's Hospital of Michigan, she was happy to "work at a place committed to taking care of the needs of those who really need the help, not because of any profit to be made, but because it has to be done. Someone must be available to promise the poor that some physicians care more about their health than how the bill will be paid."

Making a Mark at Children's Hospital of Michigan

In 1983, Canady began working at Children's Hospital of Michigan in the Detroit Medical Center. She saw this job as an opportunity to "work at a place committed to taking care of the needs of those who really need the help, not because of any profit to be made, but because it has to be done. Someone must be available to promise the poor that some physicians care more about their health than how the bill will be paid." In 1984, she became certified by the American Board of Neurological Surgery. That same year she took a position as an associate professor at Wayne State University in Detroit and was named Children's Hospital's "Teacher of the Year."

In 1986, Canady was named the assistant director of neurosurgery at the hospital. The following year, she accepted a position as the chief of pediatric neurosurgery. She thus became the first African-American woman to hold such a position in the United States. Canady made the neurosurgery program at the hospital one of the best in the country. She also continued to redefine the role of a surgeon. "One of the things I think surgeons have to do is shift emphasis," she noted. "My job is really not to cut [operate]. My job is to help people, which often includes cutting, and that's a very different focus."

Canady also changed the world of neurosurgery to include women and people of color. "The other side of racism is that if you get to be where I am and you're black, they figure you must be really damn good and you

get a little bonus for it," she remarked. "When I, a black neurosurgeon and director of the department, walk in and see a family, I must be a messiah. They perceive me as being more powerful than a white physician in the same role. It's just racism in a more benign form."

Canady also emerged as a leader in the effort to improve medical treatment for black people. She has noted that there is a lack of research addressing the specific health concerns of African-Americans, and that the medical treatment of blacks is often based on preconceived ideas. She has worked hard to dispel many medical myths, including the notion that socioeconomic status contributes to the high rate of infant mortality and the low birth weight of African-American babies. Still, she admits that this is an uphill battle for the time being. "Medical politics reflects American politics," she stated.

When speaking to children seeking career advice, Canady stresses the importance of exploring different options in order to make the best individual choice. "The thing is not about being a neurosurgeon. It's about being something, wanting to be something. I think one of the biggest limiting factors in anyone's life is confining themselves. Whether in personal ambitions or academic achievement, so much is possible that if you limit yourself it seems somehow sad. One should look for the hardest and biggest challenges and go up against them. The experience will make you stronger."

In 1989, at the age of 38, Canady was inducted into the Michigan Women's Hall of Fame. "Being honored so early in life is difficult," she said at the time. "I don't consider that I've capped my career." Over the next few years she continued to impress the families that she worked with as well as her colleagues. Longtime associate Dr. Steven Ham remarked that Canady "is a natural leader. She is sought after by the community and is very giving of her time. A short day for her is 12 hours and her schedule after hours is full, too." Many families from nearby states traveled to Michigan just to get Canady to treat them.

A Dedication to Children

Canady has often mentioned the importance of mentors in her career. For this reason, she has made herself available as a mentor, particularly to young African-American girls who wish to follow in her footsteps. "I didn't consider myself a role model until it became clear that others did," she said. Canady speaks to children at schools and welcomes youngsters seeking career advice. Instead of pushing these young people toward a career similar to hers, she stresses the importance

of exploring different options in order to make the best individual choice. "The thing is not about being a neurosurgeon. It's about being something, wanting to be something," she said. "I think one of the biggest limiting factors in anyone's life is confining themselves. Whether in personal ambitions or academic achievement, so much is possible that if you limit yourself it seems somehow sad. One should look for the hardest and biggest challenges and go up against them. The experience will make you stronger."

Above all, Canady has found that working with children as her patients is the most rewarding aspect of her career. She admires the fact that children "view life on a day-to-day basis, they're not worried about what's going to happen next week or next month. It's what's going to happen five minutes from now. That lets them live in the moment, and I think we as adults could do better with that." When she treats children, Canady tries to play with her patients as much as possible and get to know them. Still, she acknowledged that working with children has its painful side as well: "The biggest challenge is you are dealing with very sick children and you are not in control of the situation; the situation controls you. You get to be a part of people's families in a very intimate way. You get to see the strengths of the human spirit that can survive terrible, devastating things, perhaps a situation where their child is dying. You can't make it not painful, but you can certainly make it much easier in terms of their understanding of what's happening."

Beyond the Operating Room

As a neurosurgeon, Canady has many areas of expertise, including abnormalities of the head and face, epilepsy, and tumors of the brain and spinal cord. In addition to her surgical duties, Canady devotes herself to research and development of tools that will further contribute to the well being of patients in need. One of her greatest accomplishments is the invention of a patented valve that was developed in conjunction with other members of the medical staff at Wayne State University. The valve allows spinal fluid to flow through the brain from two different directions, rather than one, therefore easing the trauma for patients who suffer from hydrocephalus, which is also known as water on the brain. Canady has also dedicated herself to fundraising so that similar research can continue in the future.

In 2001, Canady made the difficult decision to retire from Children's Hospital. She once said, "I love working at the hospital. It's been joyous. I'll work until it is no longer fun." While she still enjoyed her work, she felt that the years of maintaining such a rigorous schedule had finally taken

their toll. Upon her retirement in June 2001, Canady was honored with several receptions at the Wayne State University School of Medicine. A short time later, she and her husband moved to Florida. Canady remains active in the medical field, though, conducting her own research and writing articles about new advances and technology in neurology and pediatric surgery.

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MARRIAGE AND FAMILY

In 1988, Canady married George Davis, a retired recruiter for the U.S. Navy medical corps. They met at a medical convention in Dallas, Texas, where he was trying to recruit doctors. They do not have any children, but they enjoy spending quality time together. Canady referred to her marriage as "the best thing I did with my life. Everything else is relatively conditional, but with my marriage, I don't have to be anything different than who I am." She credits her husband's military background as an essential part of their successful marriage. "He knows what it is to have a sense of duty," she said.

HOBBIES AND OTHER INTERESTS

In her free time, Canady enjoys traveling, reading, and watching television and movies. But she is careful to avoid viewing too much violence. "I can't watch people get shot and cut up in the movies. It freaks me out," she stated. "You're being a voyeur, you can't intervene, you can't help. This is a very different quality than going to the emergency room where somebody's got blood and gore all over the place and you can do something." Canady also enjoys video games. She loved to trade playing tips with the many young patients she worked with throughout her career.

HONORS AND AWARDS

Alpha Omega Alpha Honorary Medical Society: 1975
Women's Medical Association Citation: 1975
Teacher of the Year (Children's Hospital of Michigan): 1984
Woman of the Year (National Association of Negro Business and Professional Women's Club): 1986
Candace Award (National Coalition of 100 Black Women): 1986
Michigan Women's Hall of Fame: 1989
President's Award (American Medical Women's Association): 1993
Athena Award (University of Michigan Alumnae Council): 1995

FURTHER READING

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Rimm, Sylvia, and Sara Rimm-Kaufman. *How Jane Won: 55 Successful Women Share How They Grew from Ordinary Girls to Extraordinary Women*, 2001
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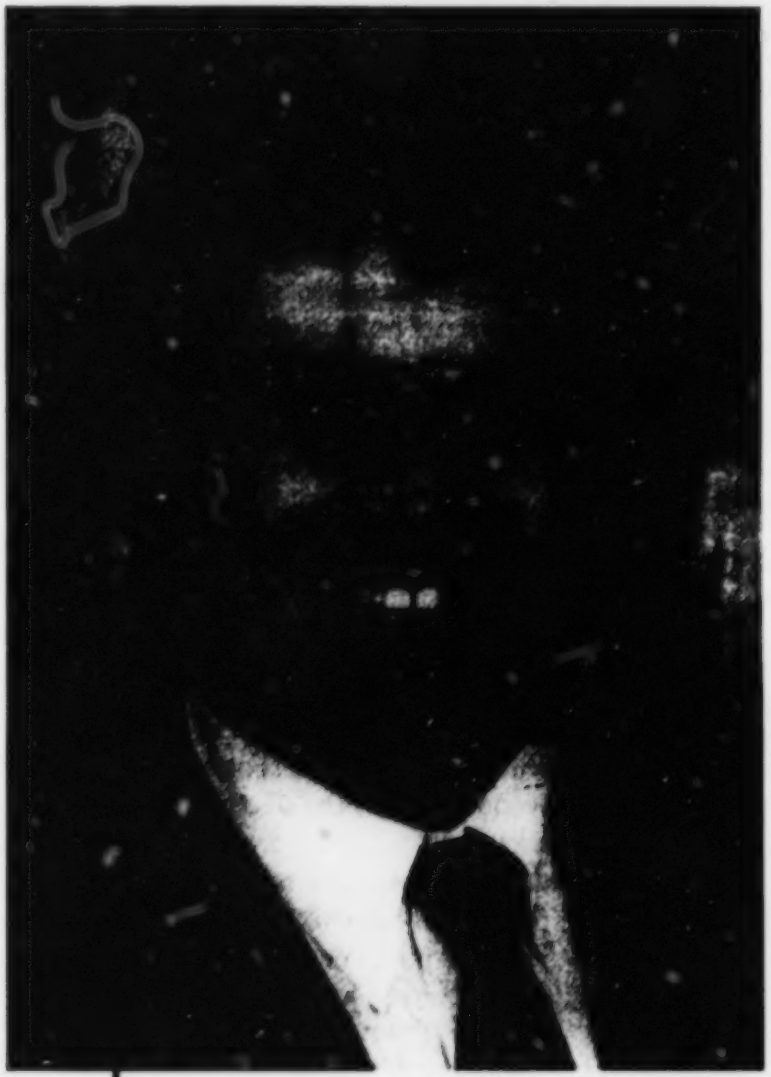

Arthur Caplan 1950-

American Philosopher and Bioethicist
Director of the Center for Bioethics at the University of Pennsylvania

BIRTH

Arthur Leonard Caplan, known as Art, was born on March 31, 1950, in Boston, Massachusetts. He was the oldest of three children born to Sidney D. Caplan, a pharmacist, and Natalie Caplan, a homemaker.

YOUTH

Caplan grew up in the Boston suburb of Framingham, Massachusetts. His parents were interested in politics and enjoyed a good debate at the dinner table. "It would not be an odd thing to come to my house at dinnertime and find four people talking simultaneously," Caplan remembered.

As a young child in the hospital, Caplan wondered why the doctors never admitted that his fellow patients had died. Instead, they told him that the desperately ill children had been allowed to go home. "That definitely got me interested in ethics. I thought about things like why didn't the hospital let your parents stay over [a common rule at that time]. I wondered about why such a bad thing had happened to me since I was such a good kid."

When Caplan was six years old, he contracted polio, a viral infection that invades the nervous system and causes paralysis. He spent two months in Massachusetts General Children's Hospital fighting the disease. "I missed a good chunk of first grade and went to rehab [rehabilitation] for many years after," he recalled. Luckily, he eventually made a full recovery.

Caplan's early experience as a patient helped raise his interest in the problems of medical care. For example, he wondered why the doctors never admitted that his fellow patients had died. Instead, they told him that the desperately ill children had been allowed to go home. "That definitely got me interested in ethics," he noted. "I thought about things like why didn't the hospital let your parents stay over [a common rule at that time]. I wondered about why such a bad thing had happened to me since I was such a good kid."

EDUCATION

Caplan received his early education in Jewish schools. He then attended Framingham North High School, where he played lineman on the football team and made the National Honor Society. After graduating from high school in 1967, he went on to attend nearby Brandeis University. Caplan majored in philosophy—a field of study that considers broad questions relating to the nature of the universe and human existence. "It was like intellectual wrestling," he said of his chosen field. "The people in it were very

sharp, and I wanted to go at it with them." After earning a bachelor's degree (B.A.) from Brandeis in 1971, Caplan continued his education at Columbia University in New York. He received a master's degree (M.A.) in philosophy in 1973, and a second master's degree (M.A.) in history and the philosophy of science in 1975.

During his years as a graduate student at Columbia, Caplan was invited to teach a course on ethics for medical students. (Ethics are rules or standards that govern people's behavior and help them to make moral choices.) The course turned out to be a dismal failure because Caplan did not understand the practical medical issues the students faced. Instead, he concentrated on teaching them broad philosophical theories. "The course was terrible. Students hated it, dropped it," he remembered. "In a fit of ethics, I said I shouldn't get paid." But Caplan learned a great deal from the experience and became fascinated with the ethical problems facing doctors. He spent the next year as an observer in Columbia's medical school, doing rotations in different areas and talking to patients. "Med school was like a giant philosophy lab," he noted. "It was full of drama and ethical questions." Caplan earned a doctorate degree (Ph.D.) in philosophy from Columbia in 1979.

CAREER HIGHLIGHTS

Beginning in 1977, while he was still a graduate student, Caplan worked at the Hastings Center in New York. This organization was known as a "think tank" because it brought together great minds from various fields to study and propose solutions to society's problems. He remained at the Hastings Center for the next ten years, rising to the position of associate director. During his years at the Hastings Center, Caplan helped promote federal laws to encourage organ donation and to create living wills (a document that enables people to refuse to be kept alive with life-support systems if they are terminally ill). In addition, he continued to teach at Columbia during this time.

In 1987, Caplan became a professor of philosophy and director of the Center for Biomedical Ethics at the University of Minnesota. Over the next seven years, he dealt with ethical issues surrounding organ transplants and other medical procedures. In 1995, Caplan was named director of the Center for Bioethics at the University of Pennsylvania, commonly known as Penn. One of the reasons he decided to make the move was that Penn is known for its expertise in genetics (the study of how traits are passed down from parents to children through genes, the basic units of heredity). Caplan believes that genetics will be one of the most important issues in the future

of medicine. "Minnesota didn't have that," he explained. "Their expertise was in transplants."

The mission of Penn's Center for Bioethics is "to advance scholarly and public understanding of ethical, legal, social, and public policy issues in health care." Caplan and 20 other faculty members conduct courses, conferences, and seminars for health care professionals and researchers. Caplan also does original research aimed at improving different aspects of medical care.

Recognized as an Expert in Bioethics

As his career progressed, Caplan became known as an expert in dealing with the sensitive ethical issues surrounding modern medicine and health care. He has tackled questions relating to organ transplants, assisted suicide, genetic testing, human cloning, and a wide variety of other issues. "Caplan's particular skill is an ability to identify, analyze, and explain the extremely complex moral questions that grow out of changes in health care, science, and medicine," Claudia Dreifus wrote in her book *Interview*.

Caplan was one of the first people in the United States to build a career around medical ethics. He admits that it took time for bioethics to be recognized as a legitimate area of study. "When I got started in this field, I think it was regarded as a fad," he noted. "But during the 1980s, we began to see and hear everybody talking about medical ethics. Things that were once relegated to the back pages became front-page news." One of the earliest cases to capture public attention involved Karen Ann Quinlan, a young woman who was hospitalized with an unreversable coma. At that point, a mechanical respirator was helping her breathe. In 1976, her parents went to the U.S. Supreme Court to obtain the right to take her off of life support (the mechanical respirator). They wanted to allow her to die a natural death. The doctors refused to take an action that could lead to her death, but her parents fought for the right to refuse medical treatment. The courts ultimately sided with the parents. Quinlan was taken off the respirator, but she continued to breathe on her own. She remained in a coma

for 10 years and died of pneumonia. Since the Karen Ann Quinlan case, new questions have turned up every day because of advances in medical technology. "People are in the grips of bioethics fever today," Caplan acknowledged. "It used to be that I'd have to fight to get any coverage for these kinds of issues. Nowadays, there's so much bioethics in the news that there are times when I can't keep tabs on it all."

The main emphasis of Caplan's work is to encourage public debate about up-and-coming issues in bioethics. "People are skeptical that ethics can keep up [with changes in medical technology]," he explained. "They feel that the newest developments are moving at a pace that is just beyond their ability to follow. They feel completely terrorized by things like cloning, by test tube baby technology. . . . I think there's a desperate hunger to talk about these things, particularly among younger people, and society has done nothing to feed that appetite. Kids want to talk about it, and we're not helping them."

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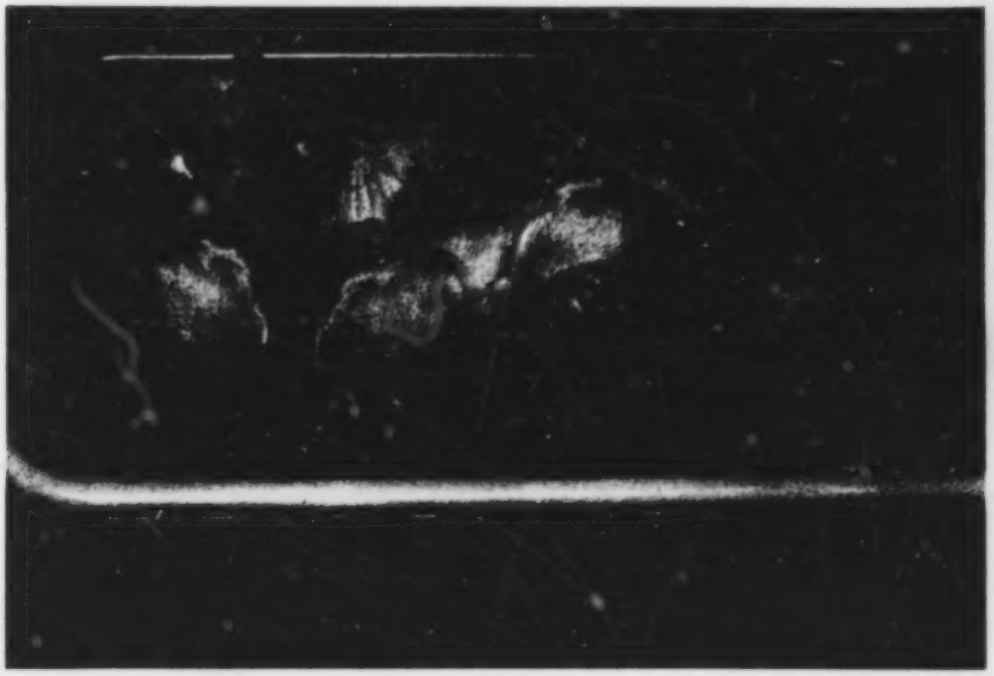
Commenting on Ethics Questions

Caplan's job as a bioethicist involves analyzing various situations relating to medical research and health care and providing advice about the most ethical ways of handling them. He has weighed in on numerous issues that have generated headlines in recent years. For example, he is an outspoken critic of Dr. Jack Kevorkian, who came to public attention by helping several of his terminally ill patients commit suicide. Kevorkian also became a vocal figure in the "right-to-die" movement, which sought greater rights for chronically ill and dying people to receive help from doctors in putting an end to their suffering.

Caplan believes that Kevorkian's role as an advocate for the right to die should disqualify him from deciding who should die. He also disagrees



These five piglets are currently the subject of ethical debate. Born in January 2002, they represent a major step toward transplanting animal organs into humans. Scientists altered the genetic makeup of these piglets by inactivating the gene that leads the human immune system to reject transplanted pig organs. That should make their organs more suitable for transplant into humans.

with the concept of doctor-assisted suicide. "I think this is one place where a person ought to take personal responsibility," he stated. "It should not be easy. Or made easy. Besides, medicine's job is to make the case for why you should stay here. How will people be able to trust doctors if they know that under some circumstances, the doctor can kill you. . . . The bigger reason this movement disturbs me [is that we] still don't have a national system of health care. To have the right to die before you have the right to [medical] treatment, seems a little bit backwards. I worry about abuse."

One of the earliest medical issues that Caplan became involved with was organ transplants. It is medically possible to transplant certain organs from one body to another. Family of the recently deceased donor must give permission for this to be done. There is a great need for donor organs, and there are lengthy waiting lists of very sick people who hope to get a transplanted organ. Caplan is particularly concerned about finding the most ethical way to allocate the small number of available organs among the large number of people who need them. A common rule is to give organs to the sickest patients first. But Caplan argues that this rule should not be

applied blindly, because sometimes the sickest patients also have the smallest chance of success with the transplant.

Caplan is frequently asked whether people whose behavior contributed to their need for an organ transplant should be prohibited from receiving one. For example, some people are reluctant to give new livers to alcoholics, or new lungs to people who smoke cigarettes. Caplan argues that past behavior should not be a factor in the transplant decision. "Medicine isn't very good at doing character tests to gauge the virtue of patients, so it should stay indifferent to whom it treats," he noted. "There are plenty of people on the waiting list for hearts who aren't nice people. Some need hearts because they've smoked, used drugs, ate too much, never exercised, or perhaps they got shot. There are too many sinners out there."

In the 1990s, Caplan created a controversy by arguing that a young man who was serving a prison term for dealing drugs should receive a new heart. Despite the man's crimes, Caplan pointed out that he was a father of small children, and that he would become eligible for parole [early release from prison] in a few years. In addition, the procedure had a high chance of success.

Caplan does not support genetic engineering. "It's one thing to treat diseases. It's another . . . to start picking the traits . . . of your kids according to what we want—sex selection, height, musical ability, personality characteristics."

A topic that currently holds a great deal of interest for Caplan is genetics, particularly the Human Genome Project. This is a complicated international effort to identify and determine the function of all of the thousands of genes in human cells. (For more information on the Human Genome Project, see the entry on Francis Collins in this volume of *Biography Today Scientists*.) Caplan believes that the successful 2000 completion of the Human Genome Project will cause fundamental changes in the practice of medicine. For example, he thinks that genetic testing will soon become available that will enable people to know their genetic risk for various diseases, like cancer. Although he is excited about the possibilities of genetic testing, he is also worried about some of the ethical issues involved. "Genetics reveals things," he explained. "It can tell you things about your ancestors, it can tell you things about your siblings. It can tell you things you never wanted to know, and it can tell others things they never wanted to know."

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> *"I've probably been the person to make bioethics a public event, and I deliberately did it. Not for the fame of it, but because that's the way you get the ears of the politicians who live and die by the media. That's the way to reach patients. And sometimes, through the media, you can shape discussions in society, get people to pay attention to topics."*

One potential future application of genetics is genetic engineering: to allow parents to "design" their children genetically. Theoretically, parents could select traits to enhance their children and make them more attractive, intelligent, artistic, or athletic. Caplan does not support this use of the medical technology. "It's one thing to treat diseases," he stated. "It's another . . . to start picking the traits . . . of your kids according to what we want—sex selection, height, musical ability, personality characteristics." In fact, Caplan believes that some aspects of human development cannot be genetically designed. "The weird thing is that people are ornery," he noted. "If you breed them to be something, they are probably going to show you that they don't want to be that. If I say right now to my son you will be a philosopher, you will be a doctor, a doctor of philosophy, he's going to say, 'To heck with that.' I assume he has picked up some of my genetic propensities, but he may not choose to use them or he might put them in a different direction."

Reproduction is another issue that has engaged Caplan in recent years. Scientists have long studied the idea of cloning, and they succeeded in 1996 when they created Dolly, the first cloned sheep. Caplan has addressed the ethics of cloning both animals and humans. He has repeatedly warned that as scientists attempted the cloning process, many animals have been born with birth defects or have died prematurely. Attempting to clone humans would surely lead to the same results. A related issue is that of stem cell research. Stem cells are found in the very earliest human embryos, just a few days old. Stem cells can differentiate to become any of the different types of cells in the human body, like skin or muscle or nerves. Stem cells hold great promise to researchers who hope to study them and use them to treat diseases. Also, scientists hope to use them to create new organs for transplant. Caplan has examined the ethical issues raised by the origin of these stem cells, which come from human embryos.

Raising Bioethical Issues in the Media

Over the years, Caplan has become something of a celebrity because of his willingness to discuss questions of bioethics in the national media. He believes that it is important to debate such issues in public. "I've probably been the person to make bioethics a public event, and I deliberately did it," he admitted. "Not for the fame of it, but because that's the way you get the ears of the politicians who live and die by the media. That's the way to reach patients. And sometimes, through the media, you can shape discussions in society, get people to pay attention to topics."

Thanks to his positive view of the media, Caplan receives countless phone calls from reporters and talk show hosts asking him to provide comments for a story or appear as a guest on television. "I get quoted a lot because I'm quick on my feet when somebody calls, I can boil the issues down to plain English readers will understand, and I have a sense of humor," he noted. "I like being engaged in the public policy debate. . . . If you want to affect policy, you can't wait the months it takes to get a scientific paper out."

Some of Caplan's colleagues resent the amount of attention he receives in the media. They claim that he spends too much time talking to the press and not enough time doing scholarly research. They also say that his comments to reporters make complex ethical issues seem overly simple. "I have my critics," he acknowledged. "Mostly, they think I shouldn't spend time yakking to the masses. My answer to them is that philosophy as it's often done is too removed, too disengaged, and renders many of its practitioners unemployable. To me, the whole point of doing ethics is to change people, to change behavior. Why else do it?"

As part of his quest to inform the public about issues in medical ethics, Caplan has written or edited over 20 books on the subject. His works include three collections of original essays. His first book of essays, *If I Were a Rich Man Could I Buy a Pancreas? And Other Essays on the Ethics of Health Care*, was published in 1992. It fea-

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tures essays on a variety of moral conflicts, such as human and animal experimentation, reproduction technology, the distribution of organs for transplants, and the Human Genome Project. His 1997 book, *Due Consideration: Controversy in the Age of Medical Miracles,* is a collection of his newspaper columns about medical controversies in the news. In 1998, Caplan again addressed these medical issues in another collection of essays and articles called *Am I My Brother's Keeper? The Ethical Frontiers of Biomedicine.* In a review for *JAMA,* John La Puma called this book "an exciting, fresh introduction about distrust in medicine." Caplan has also published hundreds of journal articles on bioethics, health care policy, and the philosophy of health care. In addition, he is the author of a syndicated newspaper column that poses ethical dilemmas for readers to consider.

The Future of Bioethics

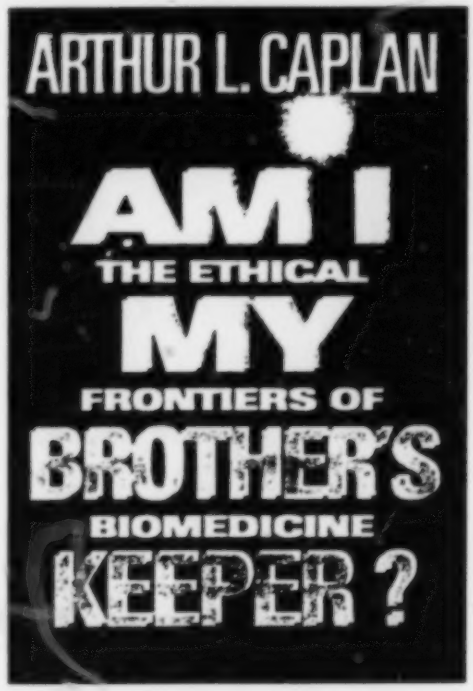
Caplan believes that the field of bioethics will continue to expand in the future. "Every week there is another hand transplant, a debate on cloning, a scandal in psychiatric research. It just sort of parades along at a hyper pace," he said. "These discussions, coupled with the ongoing advances in genetics, reproductive technologies, and neuroscience, bode very well for generating new ethics problems for future bioethicists."

"We aren't doing a good job teaching ethics to our basic scientists. We give them a basic one-week research ethics course and that's it. We have to start to realize that the best protection we've got against abuse or misuse of science is not the legislator, it's not the bioethicist, it's the scientist who feels responsibility and thinks about what they're doing."

Caplan acknowledges that it will be difficult for bioethicists to keep up with the rapid advances in medical technology. To address this problem, he suggests that doctors and medical researchers receive more training in ethics to help them make moral decisions as situations arise. "We aren't doing a good job teaching ethics to our basic scientists," he stated. "We give them a basic one-week research ethics course and that's it. We have to start to realize that the best protection we've got against abuse or misuse of science is not the legislator, it's not the bioethicist, it's the scientist who feels responsibility and thinks about what they're doing."

MARRIAGE AND FAMILY

On June 6, 1971, Caplan married psychologist Janet Stojak, whom he met as a student at Brandeis University. Their son, Zach, was born in 1984. Caplan and his wife were divorced in the late 1990s. He lives in suburban Philadelphia, Pennsylvania.



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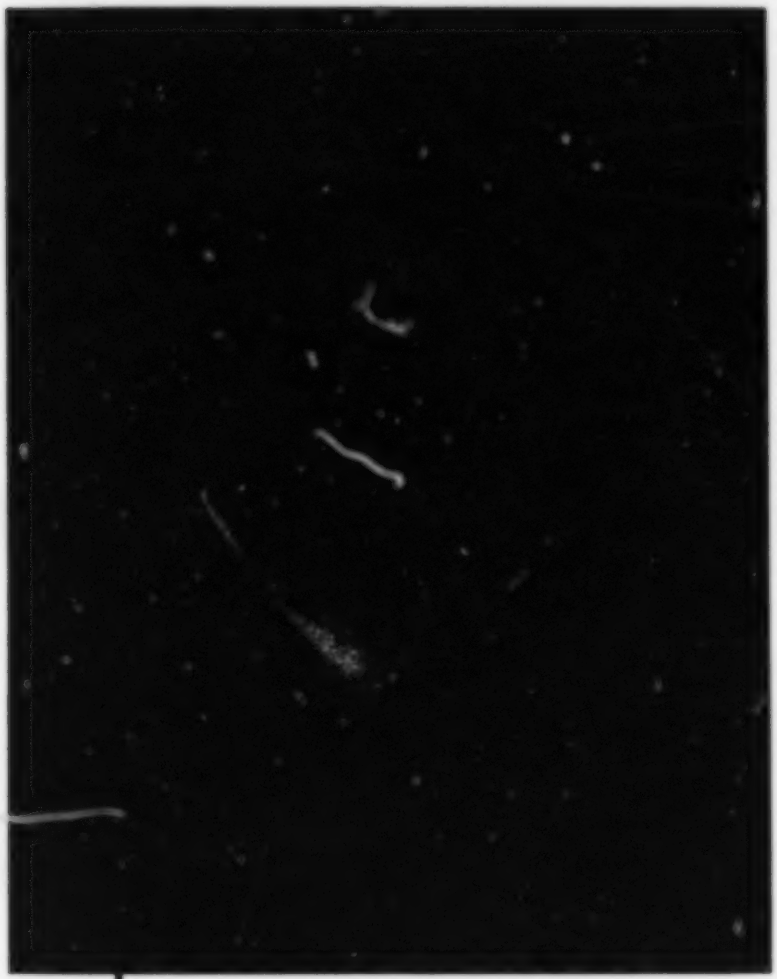
WORLD WIDE WEB SITES

http://www.uphs.upenn.edu/bioethic/center/people/caplan.shtml
http://www.biography.com



Francis Collins 1950-

American Geneticist and Director of the National Human Genome Research Institute
Led a Team of Scientists Who Successfully Mapped and Sequenced Human DNA in 2000

BIRTH

Francis Sellers Collins was born on April 14, 1950, in Staunton, Virginia. His father, Fletcher Collins, was a professor of English and drama at a local college. His mother, Margaret Collins, was a playwright and actress. Francis has three older brothers, Christopher, Brandon, and Fletcher.

"Every summer when I was a kid we had a summer theater, which meant there were anywhere from six to 12 people staying at our farmhouse working on one play after another. As I got older, I was involved myself in the plays. That's actually good training for scientists to get over the jitters of being in front of an audience."

YOUTH

Collins was raised on a 95-acre farm in Virginia in a house without indoor plumbing. His parents had moved there from Long Island, New York, before he was born because they wanted to live a simple life in the country. Collins has called his parents "wonderful, fascinating" people who contributed to his lifelong love of learning. He remembers Staunton as "a friendly, comfortable place to grow up," but he also found the town rather dull.

During Collins's childhood, his parents formed a drama group called the Oak Grove Players and opened a small theater on their farm. They staged plays every summer, many of which were written by Collins's mother. When Collins was seven, he wrote and directed his own version of *The Wizard of Oz* at the theater. "Every summer when I was a kid we had a summer theater, which meant there were anywhere from six to 12 people staying at our farmhouse working on one play after another," he recalled. "As I got older, I was involved myself in the plays. That's actually good training for scientists to get over the jitters of being in front of an audience."

EDUCATION

Collins was a very bright child. His mother claims that he had learned to read by the age of three. Deciding that the local schools were not good enough to challenge her boys, Margaret Collins taught Francis and his brothers at home. She liked to present a certain subject intensively for several days in a row, and then move on to another. "It was a bit disorganized," Collins admitted. "I'm sure it would not have been deemed appropriate by today's standards." He finally began attending the public schools in Staunton in the sixth grade.

By the time he entered Robert E. Lee High School, Collins had developed a strong interest in chemistry and was considering pursuing science as a career. Although it may seem strange, he never liked biology. "Somehow, I

had the notion that life was chaotic and that whatever principles governed it were unpredictable," he explained. Collins graduated from high school in 1966, at the age of 16. He went on to earn a bachelor's degree (B.S.) in chemistry with highest honors from the University of Virginia in 1970. He married his high school sweetheart, Mary Lynn, during his senior year, and they started a family a short time later. Money was tight for Collins and his young family throughout his college days. He remembers mowing lawns, painting houses, cutting down trees, and doing other odd jobs for neighbors in order to make ends meet.

After graduating from Virginia, Collins continued his education at Yale University in New Haven, Connecticut. He studied physical chemistry, earning his master's degree (M.S.) in 1972 and his doctorate degree (Ph.D.) in 1974. By the time he completed his Ph.D., however, Collins had begun to rethink his objections to biology. "I closed my eyes to the life sciences because I thought they would not satisfy my need for a principle-based discipline. I closed my horizons down very prematurely. I was a science nerd," he admitted. "[Chemistry] began to feel rather flat. I realized it was time to get out of my little box and see what else was out there. In 1972, I took a course in biochemistry, which was my first glimmer into human genetics."

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At that time, there was a revolution taking place in the fields of molecular biology and genetics. Scientists were making impressive discoveries about how various traits were passed down from parents to children through genes, the basic units of heredity. Collins decided to change his field of study to genetics in hopes that it would give him an opportunity to improve the quality of human life. He went to medical school at the University of North Carolina, earning his M.D. with honors in 1977. He then served as a resident doctor in internal

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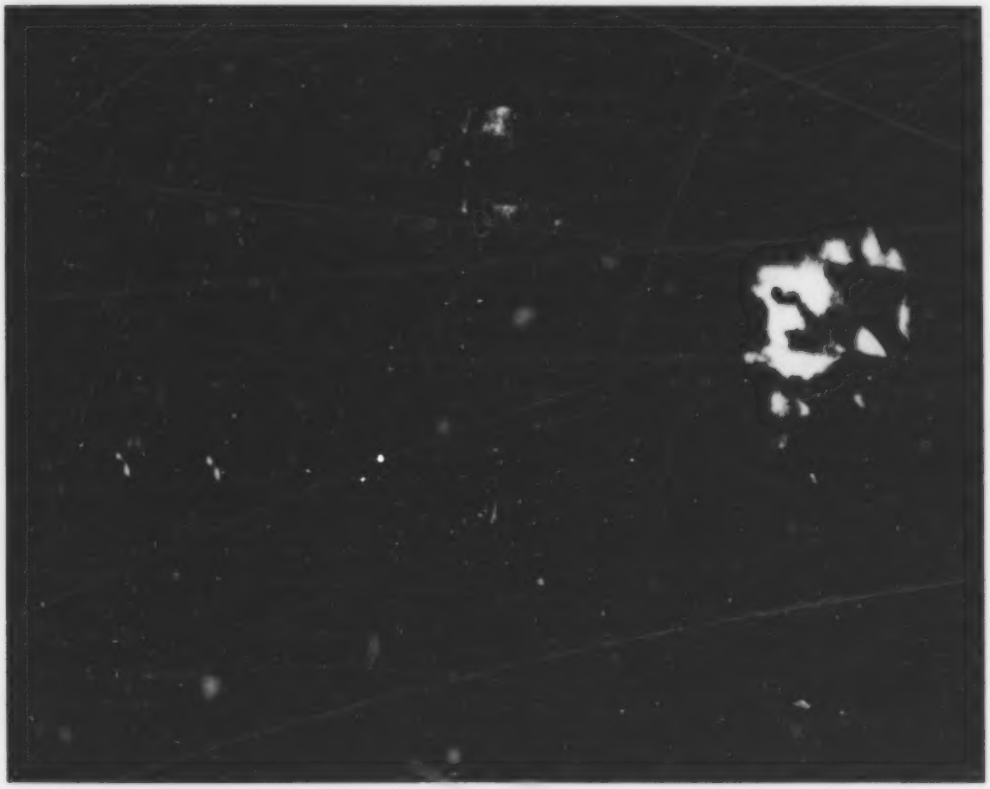

medicine at North Carolina Memorial Hospital from 1977 until 1980. Collins then returned to Yale, where he completed a fellowship in human genetics and pediatrics in 1984.

CAREER HIGHLIGHTS

Gene Hunter

Upon finishing his education, Collins joined the faculty at the University of Michigan. He started out as an assistant professor of internal medicine and human genetics, and he was promoted to full professor within a few years. Collins taught classes at Michigan, but the main focus of his work was laboratory research. Along with students and colleagues, he searched for genes that play a role in causing various human diseases. Within a short time, Collins became known as one of the world's top "gene hunters."

Genes determine a person's basic physical appearance and traits, such as their gender, height, and hair color. In addition, genes determine a person's likelihood of getting a number of different diseases. Genes are made up of long combinations or strings of four chemicals—adenine, thymine, cyto-

sine, and guanine (represented by the letters A, T, C, and G). A single gene may consist of between 50 million and 250 million of these chemical letters. The particular order of the chemicals in each gene provides a cell with instructions for producing or controlling different proteins that carry out the cell's work in the body. Some examples of specific proteins and their functions include a stomach enzyme that digests food, a brain chemical that causes depression, or a sex hormone that triggers puberty. A single "misspelling" in a gene's chemical letters can cause serious problems, like making a normal cell turn cancerous.

Scientists think that human beings have between 30,000 and 50,000 different genes. The complete set of genes is called the genome. The genome, also known as "the encyclopedia of life," is contained in each human cell and includes the complete genetic code needed to make a person. Every living organism, from simple bacteria to laboratory mice, has its own genome. Although the human genome consists of approximately three billion chemical letters, only a small percentage of these letters form genes. The remainder is "filler" or "junk" DNA with no known purpose. The genome in each cell is organized into 46 packages called chromosomes. The chromosomes appear in 23 pairs, with one-half of each pair inherited from each parent. Chromosomes are carried on a long, twisted, ladder-like molecule called DNA (deoxyribonucleic acid), which can be found inside the nucleus of each of the body's estimated 100 trillion cells.

Searching for the misplaced letters in a single gene that cause a specific disease is a very difficult task. Collins has compared the search for a disease-causing gene to "trying to find a burned-out lightbulb in a house located somewhere between the East and West coasts [of the United States] without knowing the state, much less the town or street the house is on."

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In his work at the University of Michigan, Collins developed new approaches that helped simplify the search for specific genes that play a role in causing various diseases. For example, he came up with an approach called positional cloning that enabled him to identify mutations in genes. He also pioneered a method known as chromosome jumping that helped narrow the area of the search for a certain gene. Collins explained that chromosome jumping made it easier for him to find the house (the diseased gene) once he had located the correct city (chromosome). "If you're over on one end of town and you're pretty sure you're on the wrong side of the tracks, then you can leap over to the other side of town in one experiment," he stated. By using these methods, Collins reduced the average time needed to find a disease-causing gene from 18 years to four.

Finding the Gene for Cystic Fibrosis

Collins made his first breakthrough as a gene hunter in 1989. In collaboration with scientists at the Hospital for Sick Children in Toronto, Canada, he found the gene that causes cystic fibrosis (CF). CF is the most widespread, life-threatening genetic disease in the United States, affecting one out of every 2,000 American children. People with CF suffer from an accumulation of mucus in the lungs, which makes it difficult for them to breathe and reduces their ability to fight off infections. As a result, most people with CF die before they reach the age of 30. Collins first became interested in hunting for the CF gene when he met patients with the disease during his training as a medical doctor. "I first encountered CF not as a 'find the gene' problem, but as a 12-year-old close to death," he recalled. "That's something you don't forget."

Collins's discovery of the gene for CF received a great deal of attention in the scientific community as well as in the media. Tracing a disease to a specific gene is an exciting development. It opens up whole new areas of research in terms of diagnosis and treatment. For example, scientists can study how the gene normally functions and how mutations within the gene cause the disease. "Once you have the gene you can understand the defect at the most molecular level . . . and try to put things back together again with a treatment," Collins explained. "You can't even start down the pathway of a cure without a gene."

While finding the gene is an important step, Collins emphasizes that his work is just the beginning of the process of curing CF. "The discovery of these genes is sometimes portrayed in such glowing terms that people conclude, 'My gosh, lives have already been saved by this.' They haven't. That bothers me a lot," he stated. "Finding the cystic fibrosis gene in 1989

has not yet led to a cure. But we've learned a huge amount about the normal function of that gene and how you might compensate for its lack of function. There are about two dozen new drugs in clinical trials, most of which would never have been thought of without the gene in hand."

Collins followed his impressive discovery of the CF gene with two other important achievements. In 1990, he identified the gene that causes neurofibromatosis, a disease of the nervous system that causes the growth of disfiguring tumors. Three years later, he discovered the gene responsible for Huntington's disease, a degenerative disease of the nervous system that causes loss of muscle control and brain function, and eventually leads to death. "They will transform medicine in ways we can't even predict," he said of his discoveries. "There is going to be a shift away from a therapeutic sort of medicine, where you treat someone who is already ill, to a medicine where you identify the risks a particular individual has for developing certain diseases and then try to prevent that person from ever becoming ill. . . . The problem is, we're just starting down this path, feeling our way in the dark. We have a small lantern in the form of a gene, but the lantern doesn't penetrate more than a couple of hundred feet. We don't know whether we're going to encounter chasms, rock walls, or mountain ranges along the way. We don't even know how long the path is."

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Director of the Human Genome Project

Collins's success as a gene hunter earned him a reputation as one of the world's top scientists in the field of genetics. In 1993, he was offered the position of director of the National Human Genome Research Institute.

Collins working on the microscope and computer, mapping human genes, 1993.

It's a division of the National Institutes of Health (NIH), the huge health agency run by the federal government. The National Human Genome Research Institute was created in 1989 to serve as the world headquarters of the Human Genome Project (HGP). HGP is a complicated, international effort to identify the locations of all of the more than 30,000 genes in the human genome. These locations would be used to create a "map" of the human genome. Collins and other members of the HGP hoped that this map could then be used to determine the function of various genes. The ambitious project also sought to "sequence" all human DNA, or describe the entire three-billion-letter chemical chain in the proper order, including both genes and "junk" DNA.

The Human Genome Project, co-sponsored and funded by the U.S. government and a British health fund called the Wellcome Trust, is considered one of the most important scientific undertakings of our time. "It is an audacious effort to read our own instruction book. It is a project which aims to determine the complete sequence of all of the human DNA—the hereditary material—and also to compare that to the DNA of other or-

ganisms in order to help us understand what it all means," Collins explained. "Everything we do—from the time we are a one-celled embryo until adulthood—and all the ways we fight off diseases or fall victim to them will be illuminated by understanding these instructions."

But Collins added that the challenge facing the HGP was truly immense. "If you print out the entire genome of a human being, it would fill 23 sets—not volumes, sets—of the *Encyclopedia Britannica* with every line of every page filled with strings of A, C, G and T," he noted. "To find a single gene, first you have to find the right volume, and you have to turn pages, page after page, until you hit on it."

Although Collins recognized the significance of the HGP, he was reluctant to become the director of such an enormous project. After all, the job would require coordinating the efforts of over 1,000 scientists working in 16 research centers located in 6 countries around the world. He also worried that he would be too busy to pursue his own genetic research projects. "The truth is, I did not want the job," he admitted. "I had just gone through a separation with my wife. I had a wonderful research position at the University of Michigan. And I honestly wasn't sure I was well suited to administration."

But Dr. Bernadine Healy, who was then director of the NIH, finally persuaded Collins that directing the HGP was a unique opportunity. "I remember she painted this picture of the two of us passing with our walkers in a nursing home. And she leans over to ask me what I've done with my life, and of course I answer that I've always regretted missing out on this tremendous historical opportunity. And I realized that she was right. I took

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the job," he recalled. "There is only one human genome project. It will only happen once, and this is that moment in history. The chance to stand at the helm of that project, to put my own personal stamp on it, is more than I could imagine." (For more information on Healy, see *Biography Today Scientists and Inventors*, Vol. 1, and Update in 2001 Annual Cumulation.)

As director of the HGP, Collins quickly gained a reputation as an effective manager, a team player, and a sensitive physician who was concerned about the people affected by genetic diseases as well as the ethical issues raised by genetic research. He coordinated the work of scientists around the world, gave speeches, attended meetings, and often ended up working 100-hour weeks. Despite the complex nature of the work, Collins managed to remain under the $300 million budget for the project and ahead of the 15-year schedule.

"If you print out the entire genome of a human being, it would fill 23 sets—not volumes, sets—of the **Encyclopedia Britannica** *with every line of every page filled with strings of A, C, G and T. To find a single gene, first you have to find the right volume, and you have to turn pages, page after page, until you hit on it."*

In addition to his duties as director of the HGP, Collins continued to see patients at a local hospital and also established his own research laboratory at the NIH. In this laboratory, he led a team of scientists working to find the genes that caused diabetes, leukemia, breast cancer, and prostate cancer. In 1996, however, Collins had what he has called "the most painful experience of my professional career." A student researcher who worked in his laboratory falsified data pertaining to leukemia research. This data was reported in scientific articles on which Collins's name appeared as co-author. As soon as he learned about the problem, Collins took full responsibility and made a public apology. Fellow scientists praised him for his handling of the situation.

The Race to Map the Human Genome

Under Collins's guidance, the Human Genome Project marched along throughout the 1990s. HGP researchers made steady progress in identifying new genes and sequencing human DNA. In the late 1990s, Collins announced that it appeared the project would be completed in 2003, two years ahead of the original schedule. In 1998, however, a new competitor

Collins with his colleague Dr. Jeffery Trent at the National Human Genome Research Institute.

entered the race to map the human genome. J. Craig Venter — a talented former NIH researcher with a reputation as a maverick — claimed that his corporation, Celera Genomics, would successfully sequence the human genome by 2001. Venter had the credentials to back up his claim. He first came to prominence in the early 1990s, when he developed new ways to speed the process of identifying genes. Scientists had identified 4,000 human genes by that time, and each one had required years of difficult labor. Using his new methods, Venter started finding an average of 25 new genes per day.

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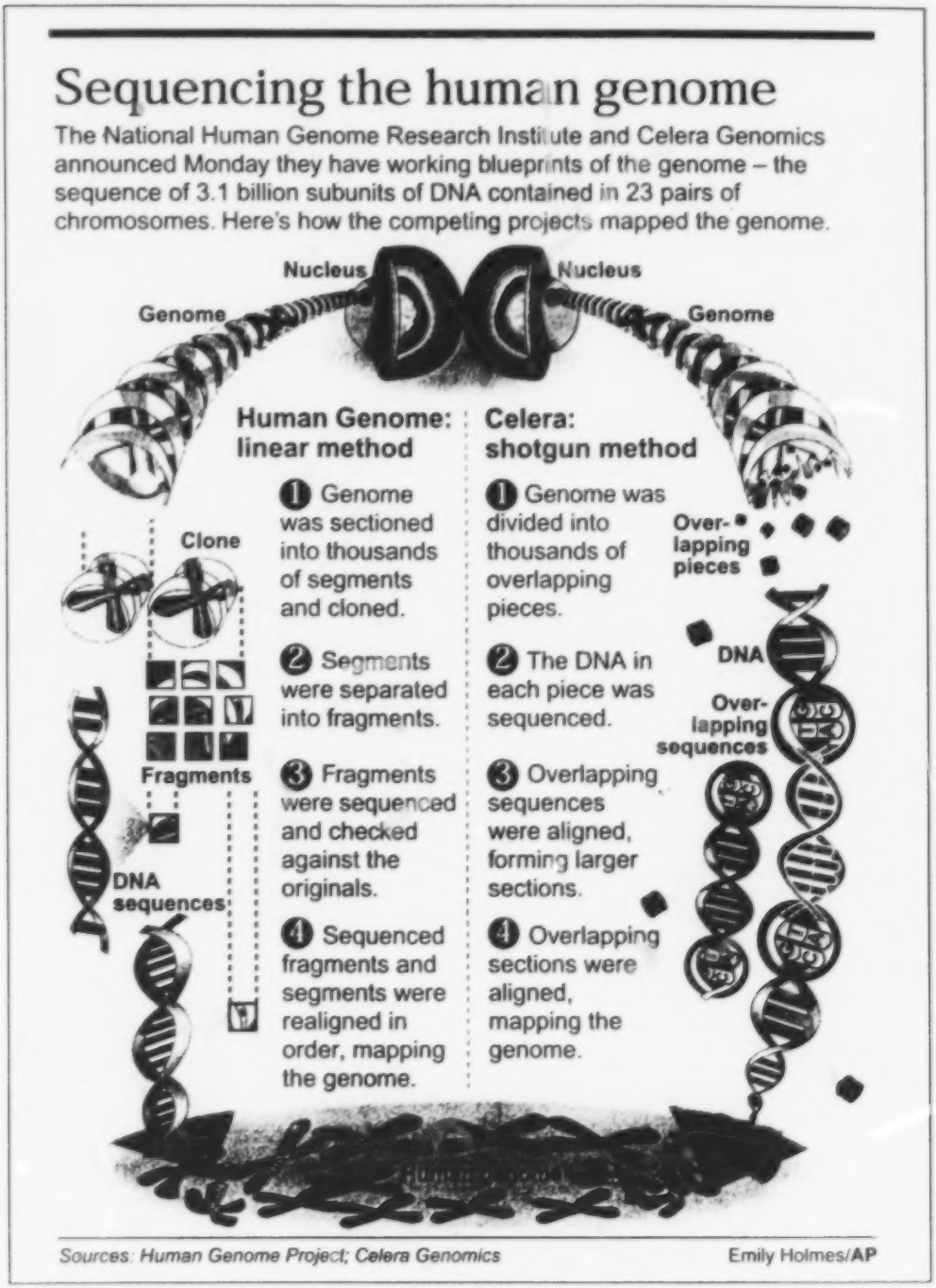
Venter's bold announcement started a fierce competition between Celera Genomics and the HGP. Collins and other researchers in the government-backed project felt pressure to be the first to complete their map of the human genome. As a for-profit corporation, Celera hoped to patent sections of the genetic code. (A patent is a legal document that gives an inventor the sole right to make, use, and sell an invention for a limited period of time. The government registers the idea as the property of the inventor, and no other person or company is allowed to use it without the inventor's permission until the patent expires. In some cases, U.S. law allows scientists and research corporations to patent their discoveries.) If Celera was able to patent the human genome, then they would be able to sell the rights to their discoveries. But the HGP scientists wanted to make the map of the human genome available to the public for free so that other scientists could use the research to find cures for genetic diseases.

"It's humbling for me and awe-inspiring to realize that we have caught the first glimpse of our own instruction book, previously known only to God. Historians will consider this a turning point. Researchers in a few years will have trouble imagining how we studied human biology without the genome sequence in front of us."

Before Celera entered the picture, the HGP scientists had concentrated on making their map of the human genome as complete and accurate as possible. But Venter and his team concentrated on identifying genes and ignored the "junk" DNA that appeared in between. The map they were creating showed only the highlights of the human genome. When the HGP was challenged by Celera, Collins reevaluated his project's approach to mapping and sequencing DNA. He discovered that the scientists who were already beginning to work with the HGP data did not require a high degree of accuracy. So Collins encouraged his team to work faster and pushed the completion date of the project up to 2001.

The competition between Collins's team and Venter's company became ugly at times. The two sides fought over who should get credit for discoveries, whose sequence of human DNA was more complete and accurate, and whether genome data should be patented or exchanged freely. But the competition also forced both teams to work more quickly and efficiently. By 1999, both Collins and Venter announced their intention to complete a rough map of the human genome by the spring of 2000. Before


Sequencing the human genome
The National Human Genome Research Institute and Celera Genomics announced Monday they have working blueprints of the genome – the sequence of 3.1 billion subunits of DNA contained in 23 pairs of chromosomes. Here's how the competing projects mapped the genome.
Nucleus
Nucleus
Genome
Genome
Human Genome: linear method
1 Genome was sectioned into thousands of segments and cloned.
2 Segments were separated into fragments.
3 Fragments were sequenced and checked against the originals.
4 Sequenced fragments and segments were realigned in order, mapping the genome.
Clone
Fragments
DNA sequences
Celera: shotgun method
1 Genome was divided into thousands of overlapping pieces.
2 The DNA in each piece was sequenced.
3 Overlapping sequences were aligned, forming larger sections.
4 Overlapping sections were aligned, mapping the genome.
Over-lapping pieces
DNA
Over-lapping sequences
Sources: Human Genome Project; Celera Genomics
Emily Holmes/AP

Reprinted from June 26, 2000.

long, discoveries were being announced at a rapid rate. For example, in January 2000, Collins reported that he recently had seen the first complete map of a human chromosome. "The first human chromosome—it happens to be Chromosome 22—was published, its complete sequence, just

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two weeks ago," he stated. "And that is a milestone of, I think, a very significant sort. We've never seen a whole human chromosome. We've never even seen a whole mammalian chromosome at one time. And there it is, all laid out in front of us—rather exciting."

In May 2000, Collins and Venter met at the home of a colleague to discuss their differences and try to find a way to work together. This meeting led to a joint announcement by HGP and Celera on June 26, 2000. At a news conference with U.S. President Bill Clinton and British Prime Minister Tony Blair, Collins and Venter said that their two teams of scientists both had succeeded in mapping the human genome. "Without a doubt, this is the most wondrous map ever produced by mankind," Clinton stated. "It will revolutionize the diagnosis, prevention, and treatment of most, if not all, human disease." Although the maps were considered to be workable rough drafts rather than finished products, Collins was excited about the results. "It's humbling for me and awe-inspiring to realize that we have caught the first glimpse of our own instruction book, previously known only to God," he noted. "Historians will consider this a turning point. Researchers in a few years will have trouble imagining how we studied human biology without the genome sequence in front of us."

The two maps of the human genome held a few surprises. For example, scientists once thought that humans probably had around 100,000 genes, but the new research showed that the total was more likely between 30,000 and 50,000. The research also suggested that all human beings are 99.99 percent genetically identical, regardless of race.

Both HGP and Celera planned to continue working to fill in the holes in their DNA sequences by 2003. Once the map of the human genome is complete, the next step will involve comparing the DNA of various individuals in order to find differences that may lead to diseases. Collins predicts that the future will hold even more exciting discoveries: "In the next five to seven years, we will have a DNA sequence in hand that will catalog human genetic variation . . . and will discover major contributors to cardiovascular disease, schizophrenia, diabetes, multiple sclerosis, and major cancers. In 10 years, diagnostic information about risk of illness will be a standard part of medicine. In 15 years, we will see a host of new genome-based drugs that will target disease in a molecular way."

Genetic Research Raises Questions

Genetic research and gene therapy (experimental treatments that involve fixing the errors in genes that cause diseases) have led to promising treatments for many diseases, but they have also raised a number of complicated issues. Collins is frequently asked to provide expert opinions about

some of the legal and ethical issues surrounding genetic research. One point of contention is whether genes and DNA can be patented by individual scientists or corporations. Collins opposes issuing patents because he feels that it slows down further research. "It puts us in a situation where there is such a tangled meshwork of patents and licenses that downstream research is actually inhibited," he explained. "A situation where somebody with a good idea is actually prohibited from pursuing it is not the way the public will benefit."

At this point, doctors are able to perform tests on pregnant women to determine whether their unborn babies are likely to have certain genetic diseases. Since few treatments or cures have been developed yet, however, the main option for couples who undergo genetic testing is to abort fetuses that will be affected by diseases. Collins personally opposes abortion, but he refuses to impose his own values on his patients. However, he does worry that extensive use of genetic testing might have a negative effect on human variety and culture. As an example, Collins points out that one of his heroes, the legendary folk singer Woody Guthrie, died of Huntington's disease. Collins argues that Guthrie's life was worth living despite the fact that he had a genetic disease. As genetic testing becomes further refined, Collins also worries that couples may only accept fetuses that meet certain gender or height requirements.

"I am driven by a sense of responsibility to try to reach out to people who are sick and a sense of frustration that many of the tools we have to accomplish that goal are far more limited than they ought to be. I am driven by the conviction that genetics holds the best promise that we've ever had to shine a light into those dark places and illuminate the mechanism of illness in a way that will lead us to a better outcome. Furthermore, as a person of faith, I can't help but look at this as a unique and remarkable opportunity to appreciate God's creation."

Another broad issue underlying genetic research involves ensuring the confidentiality of the information. Tests are becoming available that can help predict people's risk of getting breast cancer, Alzheimer's disease, and many other diseases with a genetic component. Collins wants to make sure that this information remains private so that it cannot be used against people by insurance companies or employers. He is concerned that insur-

ance companies may charge higher premiums to people who are at risk for certain diseases. He also worries that employers may require genetic testing as a condition of employment and use it to decide what types of jobs people are qualified for.

"We should not worship DNA. We should marvel at the way in which this molecule is capable of carrying information that can specify all these biological properties of human beings. And we should be incredibly excited about what that's going to tell us about health and disease, and all the advances in human medicine. But we should not lose sight of the thing that human beings are a lot more than 3.1 billion letters of a code, and there are things about us we will not understand, not now, not ever, by studying this particular molecule."

Finally, scientists are engaged in a debate over germ line therapy. This controversial type of gene therapy involves making changes to a sperm or egg cell to repair problems in genes that would have caused the resulting child to suffer from a genetic disease. The difference between germ line therapy and other types of gene therapy is that any changes made will be permanent in later generations. Collins feels that scientists do not have enough information to begin making these types of changes to human life. "The problem is that germ line gene therapy would not be shown effective until you had already gone too far down a path that you couldn't reverse," he noted. "After all, it would take generations to know whether this works. And if the answer was, oh, we cured Alzheimer's disease, but everybody is dying of something else at age 35 because of a change we made without realizing the consequences, what have we done?"

Despite his demanding schedule, Collins finds his work very rewarding. "I am driven by a sense of responsibility to try to reach out to people who are sick and a sense of frustration that many of the tools we have to accomplish that goal are far more limited than they ought to be," he stated. "I am driven by the conviction that genetics holds the best promise that we've ever had to shine a light into those dark places and illuminate the mechanism of illness in a way that will lead us to a better outcome. Furthermore, as a person of faith, I can't help but look at this as a unique and remarkable opportunity to appreciate God's creation."

Collins on his Honda Nighthawk 750.

Although Collins feels that genetic research holds tremendous promise, he also emphasizes that it does have limitations. "We should not worship DNA," he said. "We should marvel at the way in which this molecule is capable of carrying information that can specify all these biological properties of human beings. And we should be incredibly excited about what that's going to tell us about health and disease, and all the advances in human medicine. But we should not lose sight of the thing that human beings are a lot more than 3.1 billion letters of a code, and there are things about us we will not understand, not now, not ever, by studying this particular molecule."

MARRIAGE AND FAMILY

Collins married his high school sweetheart, Mary Lynn, in 1969. They had two daughters, Margaret and Elizabeth. Margaret eventually became a doctor, while Elizabeth became a social worker. Collins separated from his first wife in the early 1990s, and they eventually divorced. He is now married to Diane Baker, who is the director of the genetic counseling program at the University of Michigan.

HOBBIES AND OTHER INTERESTS

In his limited spare time, Collins enjoys playing guitar and keyboards, riding his motorcycle, and playing volleyball. He also enjoys exploring his religious faith. Collins embraced Christianity in the late 1970s. He was impressed by how much it helped his wife Mary Lynn, who suffered from depression, and how it gave strength to some of his patients. He was also influenced by the work of C.S. Lewis, a British writer who set out to disprove Christianity and ended up converting himself. Collins and his first wife helped start a church in Ann Arbor, Michigan. Collins also accompanied his daughter Margaret to Nigeria, where they spent several weeks volunteering as missionary doctors.

Some scientists are not religious, because they feel that faith conflicts with scientific principles. "Scientists, of all groups, have been the least interested in modern times in Christianity, or religion of any sort," Collins acknowledged. "Politically, it's unacceptable. It implies your intellect is weak." But after some initial resistance, he found very little conflict between his religious beliefs and his work as a scientist. "I fought it and kicked and scratched, but little by little . . . [Christianity] became the guiding force in my life," Collins said. "The Bible did have answers to questions I did not have answers to and there were no inconsistencies between the Bible and scientific ways of thinking."

HONORS AND AWARDS

Gairdner Foundation International Award: 1990
National Medical Research Award (National Health Council): 1991
National Academy of Sciences: 1993
Baxter Award: 1994
Lilia Gruber Cancer Research Award: 1995
Susan G. Komen Breast Cancer Award for Scientific Distinction: 1995
Technology Leaders of the Year (Industry Week): 2000
Biotechnology Heritage Award (Chemical Heritage Foundation and Biotechnology Industry Association): 2001

FURTHER READING

Books

Davies, Kevin. *Cracking the Genome: Inside the Race to Unlock Human DNA*, 2000
Who's Who in America, 2002

Periodicals

American Medical News, May 21, 2001, p.29
Boston Globe, Feb. 1, 1993, p.27 (Science and Technology sec.)
Business Week, June 12, 2000, p.146
Christianity Today, Oct. 1, 2001, p.42
Current Biography Yearbook, 1994
Discover, Mar. 2000, p.22
Industry Week, Dec. 11, 2000, p.47
Las Vegas Review-Journal, Oct. 17, 1999, p.B11
Los Angeles Times, June 27, 2000, p.A1
Newsday, June 27, 2000, p.D15
Newsweek, Apr. 10, 2000, p.50
Orlando Sentinel Tribune, Sep. 15, 1990, p.E3
People, Sep. 11, 1989, p.83; Nov. 6, 1995, p.107
Richmond (Va.) Times-Dispatch, May 26, 1991, p.D1; Feb. 13, 2001, p.A1; Apr. 23, 2001, p.A1
San Francisco Chronicle, Apr. 25, 2000, p.A1
Science, Sep. 1, 1989, p.923; Jan. 1, 1993, p.22; Nov. 8, 1996, p.908
Time, Sep. 17, 1990, p.11; Fall 1992, p.58; Jan. 17, 1994, p.54; Jan. 11, 1999, p.44; July 3, 2000, p.18
U.S. News and World Report, Jan. 3, 2000, p.34

Further information for this profile was taken from the news program "John McLaughlin's One on One," broadcast January 1, 2000.

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WORLD WIDE WEB SITES

http://www.nhgri.nih.gov/Intramural_research/People/collins.html
http://www.sciam.com/1998/0298issue/0298profile.html
http://www.biography.com

RETROSPECTIVE

Gertrude Elion 1918-1999

American Research Scientist and Biochemist
Developed Drugs to Treat Leukemia, Malaria, and Other Diseases
Co-Winner of the 1988 Nobel Prize for Physiology or Medicine

BIRTH

Gertrude Belle Elion (pronounced EL-ee-uhn) was born on January 23, 1918, in New York City. Both of her parents were immigrants from Eastern Europe who had arrived in the

United States in their youths. Her father, Robert Elion, was a dentist. Her mother, Bertha (Cohen) Elion, was a homemaker who cared for Gertrude and her younger brother, Herbert.

YOUTH

Elion enjoyed growing up in New York City. She was raised in an area of the city known as the Bronx, in a neighborhood filled with playmates. Elion also had a loving and stimulating home life. Both of her parents showered her and her brother with affection and attention. They also provided the children with good food, warm clothing, and a comfortable home throughout the 1930s, during the "Great Depression." The Great Depression, from 1929 to about 1939, was a time of terrible economic hardship and poverty around the world that made life difficult for many American families.

"Perhaps it was my mother who influenced me the most," Elion once remarked. "She had no higher education, but had the most common sense of anyone I knew, and she wanted me to have a career. So she was always very supportive, at a time when many women of her generation would not have been."

Elion credits her father with helping her develop a life-long love for learning and the performing arts. He often took her to performances at the Metropolitan Opera. He also helped her develop an early enthusiasm for reading. "I can remember many evenings during my childhood when I was exposed to a variety of literature, poetry, history, biography, and fiction, being read aloud by my father." Elion loved to read all sorts of books, but she was particularly drawn to books about famous scientists and other people who "discovered things." These figures fascinated her to no end. In fact, such historical figures as chemist Marie Curie and medical missionary Albert Schweitzer were her childhood heroes.

Elion's mother was another great source of love and encouragement in her life. "Perhaps it was my mother who influenced me the most," Elion once remarked. "She had no higher education, but had the most common sense of anyone I knew, and she wanted me to have a career. So she was always very supportive, at a time when many women of her generation would not have been."

Elion also enjoyed a very close relationship with her maternal grandfather. "He came over from Europe when I was about three years old, and lived very close to us, and used to take me to the park and tell me stories," she said. They also spent many afternoons strolling through the nearby Bronx Zoo during her youth. But when Elion was in high school, her grandfather was diagnosed with stomach cancer. He died when she was 15 years old, after enduring months of terrible pain. The death of her grandfather changed Elion's life forever, because it convinced her to become a scientist and dedicate her life to finding a cure for cancer. "When I was 15, I already knew from my high school courses that I loved science, but that year I was so devastated by my grandfather's death from cancer that majoring in chemistry seemed the logical first step in committing myself to fighting the disease," she said. "It was a rash decision, really. There weren't very many jobs for research scientists in those days, and there were none for women. I don't think I anticipated the trouble that was awaiting me. But I was determined to try anyway and having made my decision, I never wavered. I loved science. It was clear that there was no going back."

"When I was 15, I already knew from my high school courses that I loved science, but that year I was so devastated by my grandfather's death from cancer that majoring in chemistry seemed the logical first step in committing myself to fighting the disease. It was a rash decision, really. There weren't very many jobs for research scientists in those days, and there were none for women. I don't think I anticipated the trouble that was awaiting me. But I was determined to try anyway and having made my decision, I never wavered. I loved science. It was clear that there was no going back."

EDUCATION

Elion was a terrific student who earned straight "A's" in every class except physical education (her grades in that class suffered because she did not like to swim). When asked to explain her exceptional academic performances in school, Elion merely said that "I loved to learn everything, everything in sight, and I was never satisfied that I knew everything there was to know in each of my courses."

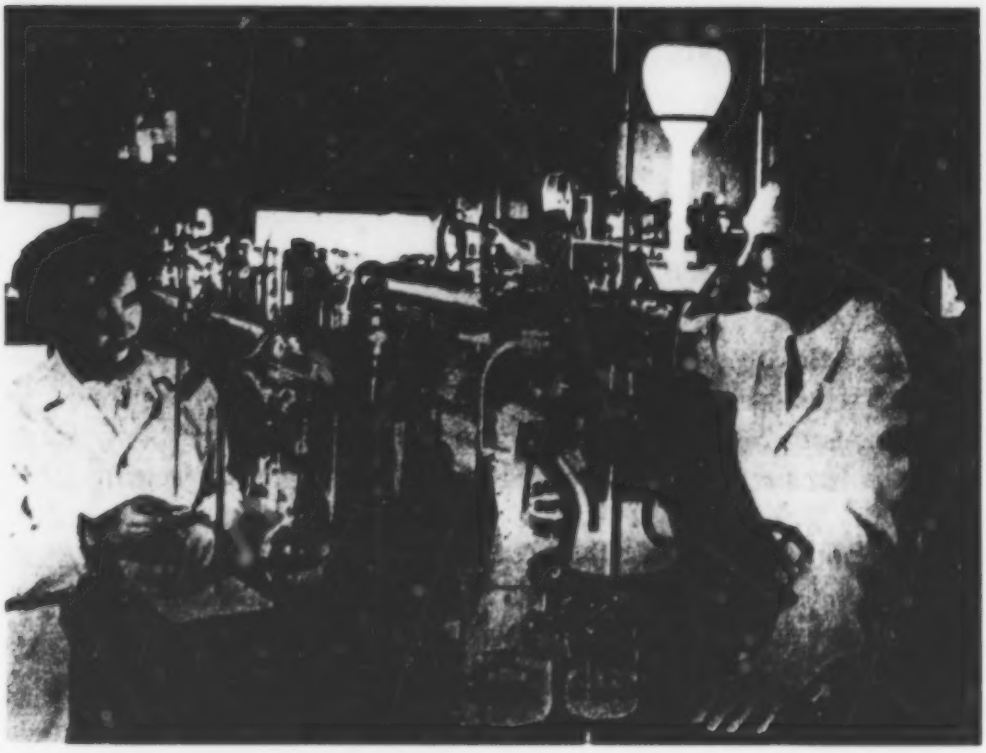
Elion cruised through school at an amazing pace, skipping four grades by the time she reached tenth grade. By that point she attended Walton High School, an all-girl public school in the Bronx. She graduated from Walton in 1933 at the age of 15. She then gained admission to Hunter College, a highly regarded women-only school in New York City that did not charge tuition to its students. She excelled at Hunter, graduating in 1937 with a degree in biochemistry and a host of academic honors.

When Elion left Hunter, she intended to continue her education in graduate school. But despite her exceptional academic record, she was rejected by all 15 schools to which she applied. Elion faced deeply entrenched sexist attitudes in both her education and in her early career. Today, nearly everyone familiar with her career agrees that the schools rejected her because American society at that time expected women to work as homemakers, not as chemists. "[Nobody] took me seriously," she admitted. "They wondered why in the world I wanted to be a chemist when no women were doing that. The world was not waiting for me."

Turned away by the graduate schools, Elion tried to secure an entry-level position in a chemistry laboratory. But once again, she was repeatedly turned away by employers who were used to filling their labs with men. "After an entire summer of job hunting, I had to face reality," she remembered. "It was the midst of a depression and jobs were admittedly scarce. But I had been given every excuse imaginable." For example, laboratory administrators repeatedly told her that they could not hire her because she would be a "distraction" to the male chemists. "That is *such* a stupid argument," she exclaimed years later. "Maybe I was young and 'cute' (after all, I was only 20 then), but I've learned over the years that when you put white lab coats on chemists, they all look alike!"

This unfair treatment deeply disappointed Elion, but she did not let the setback derail her dream. "I often wonder why I didn't give up then and there," she said. "I almost did. I actually went to secretarial school for six weeks. However, when I was offered a three-month job as a laboratory assistant in biochemistry at the New York Hospital School of Nursing, I left secretarial school and never looked back."

In 1939 Elion finally managed to gain acceptance into a graduate program in chemistry at New York University. Leaving her lab assistant position behind, she spent the next two years studying advanced chemistry. She paid for her tuition by taking on part-time work as a receptionist and substitute schoolteacher. In 1941 she graduated from the school with a hard-earned master's degree (M.S.) in chemistry.



Elion and Hitchings, about 1950.

Elion left New York University and returned to the work world just as the United States became involved in World War II. When the country went to war, millions of American men left their jobs to serve in the military. Their departure created severe shortages of workers in all sorts of fields and industries. Elion and other career-minded women quickly took advantage of the labor shortage to gain positions that had previously been denied to them because of their gender. "It was only when men weren't available that women were invited into the lab," Elion recalled. "War changed everything. Whatever reservations there were about employing women in laboratories simply evaporated."

CAREER HIGHLIGHTS

When Gertrude Elion finally got her chance to do meaningful work as a chemist, she made the most of it. In 1944 she began a four-decade-long association with George H. Hitchings, a brilliant researcher and chemist. Over that time, the two scientists collaborated to develop several important drugs that helped doctors treat leukemia (a form of cancer), autoimmune disorders, urinary-tract infections, gout, malaria, and viral herpes. Their research also helped scientists find ways to transplant kidneys and

other organs into the human body successfully. The work of Elion and Hitchings proved so valuable that they became known as two of the greatest medical researchers of the 20th century. In recognition of their amazing careers, they were awarded the 1988 Nobel Prize in Physiology or Medicine, one of the world's most prestigious honors.

Joining Hitchings at Burroughs Wellcome Laboratories

Elion's career as a chemist actually began very quietly. In 1942 she found work as a chemist for a food company, checking the quality of pickles, mayonnaise, and other foods. In 1943 she worked as a research assistant for the Johnson and Johnson pharmaceutical company. This job ended after a few months, when the project to which she had been assigned was canceled. But it did not take Elion long to find another job. In 1944 she applied for a laboratory position at Burroughs Wellcome Laboratories, another pharmaceutical firm based in New York. She interviewed with George H. Hitchings, a Burroughs researcher who wanted an assistant chemist to help him search for treatments for cancer and other diseases. As the interview proceeded, he told her all about his cell research efforts. "I didn't understand half of what he was saying, but his description of his work so enthralled me that I knew then and there that I would lose no time finding out about it," Elion remembered.

> *Laboratory administrators repeatedly told Elion that they could not hire her because she would be a "distraction" to the male chemists. "That is such a stupid argument," she exclaimed years later. "Maybe I was young and 'cute' (after all, I was only 20 then), but I've learned over the years that when you put white lab coats on chemists, they all look alike!"*

Hitchings offered Elion the assistant position based on her obvious intelligence and interest in cancer research. She happily took the job, little knowing that she would spend the next 40 years working at Burroughs, much of it at his side. But while Elion was delighted to find interesting work, she also wanted to earn a Ph.D. degree in chemistry. With this in mind, she enrolled at Brooklyn Polytechnic Institute, the only college in the area that offered graduate courses in chemistry at night.

Elion's desire to pursue an advanced degree forced her to adopt an exhausting schedule. She worked all day at Burroughs Wellcome, then traveled an hour and a half across the city to class. Then, after sitting through hours of intensive instruction, she would take a one-hour subway ride home. She did this several days a week for two years, only to have school administrators tell her that she could not continue in the program unless she quit her job and became a full-time student. Faced with the choice of continuing her education or quitting a job she had already grown to love, Elion reluctantly withdrew from school.

"Leukemia eventually became one of the most treatable forms of cancer, thanks to Elion's work. "What greater joy can you have than to know what an impact your work has had on people's lives?" she said many years later. "The thrill of seeing people get well who otherwise might have died cannot be described in words."

Unraveling the Mystery of Human Cells

During their early years of working together at Burroughs, Hitchings and Elion adopted a unique research philosophy. Most other medical researchers of the 1940s and 1950s relied on trial-and-error methods to find treatments for diseases. "The traditional approach was to take something [a medicine] that worked and to make some changes in it, and see if you could get another compound that worked as well," explained Elion. "Or to take things off the shelf and try them. Things that had never been looked at before, even natural products, or just chemicals. Well, we didn't do that." Instead, the researchers focused on trying to understand the differences between healthy and diseased cells. Each day, Elion and the other chemists in the laboratory compared normal human cells with cancer cells, bacteria, viruses, and other disease-causing agents. They then used their findings to create drugs that could kill or neutralize these agents without damaging normal cells.

Elion's first major triumph at Burroughs Wellcome involved finding a treatment for childhood leukemia, an often fatal type of cancer. She and her colleagues pursued a treatment for this disease throughout the late 1940s and early 1950s. "These were heartbreaking times," she recalled. "We seemed to be so close to the solution and yet the ultimate goal eluded us."

Elion and Hitchings after they won the 1988 Nobel Prize for their work showing it was possible to tailor drugs to fight bacteria, cancer, and other ailments.

In 1951, though, Elion discovered the first effective compound against childhood leukemia. This medicine, called 6-mercaptopurine (6MP), managed to extend the life expectancy of children suffering from leukemia up to a year. Over time, researchers learned that by using 6MP in combination with other drugs and radiation treatment, many cases of leukemia

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disappeared. In fact, leukemia eventually became one of the most treatable forms of cancer thanks to Elion's work, with recovery rates of 80 percent for certain forms of the disease. "What greater joy can you have than to know what an impact your work has had on people's lives?" Elion said many years later. "The thrill of seeing people get well who otherwise might have died cannot be described in words."

"[Laboratory research is] a team effort. There are so many aspects of drug development, finding out what the side effects are, finding out the best way to give it, finding out any number of things. One person can't do that. . . . I've always compared it, in a way, to an orchestra. Everybody plays his own instrument very well, but it isn't until you put them all together that you have anything that sounds like music."

Scientists built on Elion's work with 6MP in other ways, too. Researchers who studied her 6MP research eventually discovered that a substance created from 6MP called azathioprine (also known as Imuran) could be used to prevent the human body from rejecting transplanted kidneys or other organs. Azathioprine managed to suppress the human body's immune system. In most cases, the immune system serves a positive function, because it attacks potentially deadly viruses and bacteria. But before azathioprine came along, the immune system would also attack transplanted organs, making it impossible for doctors to perform successful transplant operations. Azathioprine, however, suppressed the immune system in a way that made life-saving organ transplants possible.

Discoveries Boost Elion's Career

As the years passed by, Elion gained a reputation as one of the finest medical researchers in the entire pharmaceutical industry. In the late 1950s, she helped create an effective treatment for malaria, a potentially deadly infectious disease that is common in tropical climates. Around this same time, she and other members of Hitchings's laboratory developed a drug that effectively cleared up a variety of urinary and respiratory tract infections.

Elion's work responsibilities increased during this period as well. She received several promotions during the 1950s and 1960s, following Hitchings up through the company's ranks. In 1967 she was named director of

the Burroughs Wellcome Department of Experimental Therapy, one of the company's major research operations. As the leader of the department, she emphasized teamwork and cooperation among all staff members. "[Laboratory research is] a team effort," she explained. "There are so many aspects of drug development, finding out what the side effects are, finding out the best way to give it, finding out any number of things. One person can't do that. . . . I've always compared it, in a way, to an orchestra. Everybody plays his own instrument very well, but it isn't until you put them all together that you have anything that sounds like music."

Elion loved leading the department's research activities. So when Burroughs Wellcome decided in 1970 to move the laboratory from New York to Research Triangle Park, North Carolina, she never even considered finding another job. Instead, she relocated to Chapel Hill, North Carolina, and resumed her directorial duties without missing a beat.

Exploring New Areas of Medical Research

In the early 1970s Elion guided the Department of Experimental Therapy into exciting new areas of research. She decided to make antiviral research a major priority, even though most other scientists believed that the field held little promise. "A few compounds had been found that inhibited the growth of viruses, [but] they were inevitably toxic to the cells," she explained. As a result, most scientists had abandoned the idea of researching treatments for viruses. Elion, however, was convinced that her laboratory could eventually develop a drug that would be able to fight viruses without damaging healthy tissue.

Elion's confidence proved to be well-founded. After several years of research and study, she and her staff unveiled a drug called acyclovir. This drug was able to wipe out viruses by preventing them from reproducing within the human body, yet spared healthy cells from damage. This compound soon became an important treatment for all sorts of viruses, from herpes to chicken pox.

Elion later stated that she never would have been able to develop acyclovir if she had feared failure. "I had fears that a particular experiment wouldn't work, or maybe a drug I thought was going to work would not. That happened, of course, all along the way. It has to happen in a long career," she admitted. "What you have to gird yourself to do is to say, 'OK, that [experiment] failed. It was a step which was in the wrong direction, so let's go back to the crossroads, and go in a different direction and not let the failure be the end of the line.'"

Elion and Hitchings posing in front of a blackboard, 1988.

Elion also never forgot that the ultimate purpose of medical research is to save people's lives. This objective guided her throughout her career and kept her from shying away from challenges just because they were difficult or time-consuming. It also led her to keep hundreds of letters that she received over the years from patients who were saved by drugs that she helped develop. "I treasure those letters," she said. "I keep every one of them."

The 1988 Nobel Prize

In 1983 Elion retired from her position as director of Burroughs' Department of Experimental Therapy. Her decision was not unexpected, but the department staff still expressed sadness at losing "Trudy," as she was called by her many friends and colleagues. After all, they were not only losing an exceptionally talented chemist, but also a skilled and inspiring administrator.

Even after her departure, though, the researchers at Burroughs Wellcome continued to build on her research and methods to make new medical breakthroughs. In 1986, for example, a group of scientists from Burroughs used Elion's work to develop azidothymidine (AZT), the first drug ap-

proved by the United States to fight AIDS. The development of AZT marked yet another triumphant moment in Elion's long and illustrious career.

In 1988 Elion was rewarded for her many accomplishments with the Nobel Prize for Physiology or Medicine. She was delighted to receive this prestigious award, which was also bestowed upon her long-time colleague George Hitchings and British scientist James W. Black. But she added that her greatest career satisfaction came from improving the lives of sick people everywhere. "People often ask whether [the Nobel Prize] wasn't what I had been aiming for all my life," she said. "Nothing could be farther from the truth. . . . My rewards had already come in seeing children with leukemia survive, meeting patients with long-term kidney transplants, and watching acyclovir save lives and reduce suffering. . . . What we were aiming at was getting people well, and the satisfaction of that is much greater than any prize you can get."

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Mentor to Young Scientists

Even after her formal retirement, Elion continued to keep an extremely busy schedule. She became a popular lecturer on medical research issues. She particularly enjoyed meeting with groups of curious schoolchildren. "The same thing that inspired me over the years inspires me now," she explained. "I want to get sick people well. I want to get children involved in science, I want them to have the same kind of excitement and fun that I've had and do something useful with their lives. . . . Children are very impressionable, they are very curious. You've got to take advantage of that curiosity, to let them realize that there is a big world out there they can discover. If you don't do it when they are young, you are not going to get them back again."

When meeting with young people, Elion would urge them to pursue careers that would enable them to do things that they enjoyed. "The most important advice is to choose the field that makes you happiest. There is nothing better than loving your work. Second, set a goal for yourself. Even if it is an 'impossible dream,' each step toward it gives a feeling of accomplishment. Finally, be persistent. Don't let yourself be discouraged by others, and believe in yourself."

Elion also served as a mentor (counselor) to medical students at the Duke University Medical Center. Some of these students admitted that the idea of having such a famous scientist as a mentor was initially intimidating, but they added that Elion quickly made them feel comfortable. "She reminded you of your grandmother or an elementary school teacher you always remember—just the pure sweetness of this person," recalled one medical student. A medical center administrator added that all of the students appreciated the "experience of working with a Nobel laureate who was brilliant and insightful, as expected, but who was also stimulating, supportive, and inspirational."

"The most important advice is to choose the field that makes you happiest. There is nothing better than loving your work. Second, set a goal for yourself. Even if it is an 'impossible dream,' each step toward it gives a feeling of accomplishment. Finally, be persistent. Don't let yourself be discouraged by others, and believe in yourself."

Elion died unexpectedly on February 21, 1999, in Chapel Hill, when she was struck down by an aneurysm (a bulge that forms on the wall of an artery or vein, often creating blood clots that can cause death if carried to the heart or brain). A few days later, hundreds of friends and fellow scientists gathered to honor her at a memorial service. The highlight of the service came when a number of friends and colleagues read excerpts from some of the patient thank-you letters that Elion had kept over the years.

HOME AND FAMILY

Elion was engaged to be married in the late 1930s, but her fiancé, Leonard Canter, died of a bacterial infection. She never considered marrying after that loss. Elion remained very close to her brother and his family through-

out her life. In fact, she took several nieces and nephews with her to the Nobel ceremonies in Europe.

HOBBIES AND OTHER INTERESTS

In her spare time, Elion attended the opera, concerts, ballet, and theater. She also enjoyed photography and travel. "Possibly my love for travel stems from the early years when my family seldom went away on vacation," she once said. "Thus, my curiosity about the rest of the world did not begin to be satisfied until I began to travel."

HONORS AND AWARDS

Garvan Medal (American Chemical Society): 1968
Nobel Prize for Physiology or Medicine: 1988
National Academy of Sciences: 1990
National Inventors Hall of Fame: 1991
National Medal of Science: 1991
National Women's Hall of Fame: 1991
Fellow of the Royal Society of England: 1995

FURTHER READING

Books

American Women Scientists: 23 Inspiring Biographies, 1900-2000, 1999
Biographical Memoirs (National Academy of Sciences), Vol. 78, 2000
Encyclopaedia Britannica, 2001
Journeys of Women in Science and Engineering: No Universal Constants, 1997
Notable Twentieth-Century Scientists, 1995
Notable Women Scientists, 2000
Remarkable Women of the Twentieth Century, 1998
St. Pierre, Stephanie. *Gertrude Elion: Master Chemist,* 1993 (juvenile)
Stille, Darlene R. *Extraordinary Women Scientists,* 1995
Who Was Who, Vol. 8, 1998-2000
World Book Encyclopedia, 2001
World of Scientific Discovery, 1999
Yount, Lisa. *Contemporary Women Scientists,* 1994

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Economist (US), Oct. 22, 1988, p.94

Investor's Business Daily, Mar. 27, 2001, p.A4
Los Angeles Times, Feb. 23, 1999, p.A20
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News and Observer (Raleigh, NC), Feb. 23, 1999, p.A1; Apr. 11, 1999, Section Sunday Journal, p.D1
Science, Oct. 28, 1988, p.516; May 28, 1999, p.1480
Sunday Times (London), Mar. 6, 1994
Time, Oct. 31, 1988, p.71
USA Today, Feb. 19, 1996, p.D1
Washington Post, Oct. 25, 1988, Health Section, p. Z10; Nov. 22, 1991, p.C3; Mar. 1, 1998, p.B9; Feb. 23, 1999, p.B5

Elion was also one of seven scientists featured in the 1999 film documentary *Me and Isaac Newton,* directed by Michael Apted. The film, which was released only months after Elion's death, was dedicated to her memory.

WORLD WIDE WEB SITES

http://www.nobel.se/medicine/laureates/1988
http://www.jwa.org

Henry Heimlich 1920-

American Surgeon and Inventor
Developed the Anti-Choking Procedure Known as the Heimlich Maneuver

BIRTH

Henry Jay Heimlich was born on February 3, 1920, in Wilmington, Delaware. His father, Philip Heimlich, was a social worker. His mother, Mary (Epstein) Heimlich, stayed at home to care for Henry and his sister, Cecelia.

YOUTH AND EDUCATION

Philip Heimlich wanted his children to grow into open-minded and compassionate adults. For this reason, he tried to expose his children from an early age to different types of people and environments. Henry and his sister often accompanied their father when he made visits to inmates in maximum-security prisons. Henry also attended a camp for juvenile delinquents as a boy, even though he did not have any behavior problems that would have required him to be there.

After completing high school, Heimlich went to Cornell University in New York. During his undergraduate years, he served as the drum major in Cornell's marching band. Upon earning his bachelor's degree in 1941, Heimlich continued his education at Cornell Medical School. He received his degree as a medical doctor (M.D.) in 1943.

MILITARY SERVICE

Heimlich continued his medical training by serving an internship at Boston City Hospital. In 1944, however, he decided to serve the United States during World War II. He joined the U.S. Navy and worked as a doctor in Navy hospitals for a while until he was assigned to take part in a dangerous mission. He was then sent to the Gobi Desert of Inner Mongolia—behind enemy lines—to serve as a surgeon for Chinese guerrilla soldiers in the fight against Japan.

Heimlich was able to save the lives of many Chinese soldiers and civilians during his time overseas. In fact, many years later the Chinese government honored him for his contributions during the war. But he always remembered the people he was unable to save. For example, Heimlich recalled one soldier who was shot in the chest during training. "Closing [the wound] was impossible. So much torn tissue. The patient died," he related. "I always felt guilty. Was there anything else I could have done?"

CAREER HIGHLIGHTS

When World War II ended in 1945, Heimlich returned to the United States and began serving as a resident physician at a series of New York hospitals, including the Veterans Administration Hospital in the Bronx, Mount Sinai Hospital, Bellevue Hospital, and Triboro Hospital. In 1950, Heimlich became an attending surgeon at New York City's Montefiore Hospital, a position he would hold for the next 19 years.

Developing Innovations That Save Lives

From the beginning of his career, Heimlich established himself as an innovative thinker who refused to shy away from controversy. "You're not being original if all your peers agree with what you're doing," he remarked. "Controversy is necessary to bring out the facts. Pain is a part of the process. You need courage and emotional control to survive it. After that, you will have confidence, no matter what."

Heimlich made the first of his many medical breakthroughs during his years at Montefiore. He came up with a way to help patients who had suffered damage to the esophagus (the muscular tube that allows the passage of food from the throat to the stomach). To help these patients resume normal eating habits, Heimlich developed a procedure that involved constructing a new esophagus from a section of the patient's stomach.

Heimlich was anxious to try out his procedure. He presented the idea to the New York Medical College—where he had been serving as an assistant clinical professor of surgery—and received a $300 grant and laboratory space to conduct research. After conducting several experiments on dogs, Heimlich was successful and published his findings in 1955. Unfortunately, the medical world all but ignored his study.

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The following year, however, Heimlich was contacted by Dr. Dan Gavrilu of Bucharest, Romania. Gavrilu had been experimenting with a similar technique on human patients for several years. Heimlich traveled to Romania and the pair collaborated in an effort to perfect the procedure. Upon returning to the United States, he began to perform the surgery on human patients. He was successful in his second attempt. Since then, the procedure has been accepted as a standard surgical technique. Heimlich has referred to the operation as "the world's first transplant."

HEIMLICH MANEUVER ON AN ADULT

Cover your fist with your other hand and thrust up and in with sufficient force to lift the victim off his feet

A.D.A.M.

For his next medical invention, Heimlich drew upon his experiences on the battlefield during World War II. He recalled seeing many soldiers with chest wounds who had difficulty breathing because excess fluid built up in their lungs. The only device available to treat these patients was a standard drainage bottle with electrical suction. Heimlich felt that he could create a superior device. During his research, he came across a toy valve that intrigued him. A short time later, he experimented with it on a human patient who was also using the standard drainage bottle. Heimlich found that his improvised valve prevented the regurgitation of fluids at a quicker rate than the bottle. Once he spread the word about his successful invention, the Heimlich valve became a standard tool in emergency rooms. A few years later, it saved hundreds of lives during the Vietnam War.

Inventing the Heimlich Maneuver

In 1969, Heimlich left New York and accepted a position as director of surgery at Jewish Hospital in Cincinnati, Ohio. During his time there, he grew

troubled by the alarming number of accidental choking deaths in the United States. Heimlich could not help but feel that the standard emergency practice for treating a choking victim—which included slapping the victim on the back or putting a finger down the throat—was not only inadequate, but potentially dangerous. He felt that this method could cause the object to become lodged further in the throat rather than helping to clear it.

Heimlich knew that the lungs always contained an air reserve. He came up with a method for using this air reserve to the choking victim's advantage. His method involved applying sharp thrusts to the soft tissue of the abdomen, just below the rib cage. These thrusts would force the air out of the lungs—and hopefully push the obstruction out of the throat in the process. In 1974, Heimlich tested his theory on dogs and found that it worked. His next step was to devise a method of applying the technique to humans.

After conducting further studies, Heimlich concluded that his procedure worked best when the person performing the technique stood directly behind the choking victim. The rescuer would wrap his arms around the victim's waist, make a fist with the thumb pointing toward the victim's chest, grab the fist with his other hand, and apply a quick upward thrust. Heimlich also concluded that the technique could be performed on victims who were lying down by compressing the diaphragm with the heel of one's hand. He even came up with a way for choking victims to perform the technique on themselves, usually by leaning over a horizontal object such as a chair and using it to press against their diaphragm. The technique took only seconds to perform and created an immediate response.

When Heimlich had finalized his technique, he wrote a report about it for a journal of emergency medicine. He realized that the technique would be controversial, so he decided to bypass the members of the medical world who would not be inclined to support it. Instead, he sent copies of his report to major newspapers and magazines in hopes of attracting some positive publicity. A breakthrough came when syndicated columnist Arthur Snider of the *Chicago Daily News* wrote an article on Heimlich's technique that appeared in hundreds of newspapers across the country. Snider asked readers to try the technique the next time they saw someone choking. Before long, Heimlich was swamped with testimonials from people including several young children, who successfully used the technique to save the lives of choking victims.

The American Medical Association endorsed Heimlich's anti-choking procedure in 1975. It became known as the Heimlich Maneuver at that time.

"I first called the technique sub-diaphragmatic pressure," Heimlich recalled. "It was the editors of the *Journal of the American Medical Association* who named it the Heimlich Maneuver. After 20 lives had been saved, they called me one day to tell me they were doing a story on the procedure and told me they wanted to name it after me. They asked: 'The Heimlich Method, or Maneuver?' They explained that a maneuver is something that you do once and it's done, whereas a method is a sequence of steps you take. I quickly decided on 'maneuver.'"

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Since Heimlich developed his life-saving anti-choking technique, it has saved an estimated 100,000 lives. Even some famous people have been saved from choking, including former President Ronald Reagan, actress Elizabeth Taylor, and singer Cher. While the Heimlich Maneuver has not been 100 percent successful, most failures have been attributed to performing the procedure incorrectly or allowing too much time to pass before applying it.

Maneuver Also Helps Drowning Victims and Asthmatics

As more and more testimonials from choking victims rolled in, people started expanding the use of the Heimlich Maneuver. For example, reports began to surface that lifeguards were using the technique to expel water from the lungs of drowning victims before performing mouth-to-mouth resuscitation. Heimlich was delighted with this news, but he was dismayed to learn that the American Red Cross still endorsed the backslap method in addition to his technique. He clashed with the Red Cross and refused to let his name be used in their official literature. "They forgot that you can't get air into the lungs until you get the water out, and the water in the lungs keeps mouth-to-mouth from being

Heimlich's daughters, Jan (left) and Liz (right), demonstrate the Heimlich Maneuver, 1982.

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effective," he explained. "The American Red Cross is responsible for every life lost, certainly from here on in, when mouth-to-mouth is done and water is in the lungs."

Heimlich won his fight with the organization in 1985. At that time, U.S. Surgeon General C. Everett Koop called Heimlich's method the "best rescue technique in any choking situation" and urged "the American Red Cross, the American Heart Association, and all those who teach first aid to only teach the Heimlich Maneuver." Heimlich's opponents soon buckled under the pressure of public opinion and endorsed his technique not only for choking victims, but also for drowning victims.

"I have an unusual position in the world. I go to China, and I'm on the posters there. I go to Russia, and I'm in the newspapers there. Even in Iran or Iraq, they know about the Heimlich Maneuver. It's put me in the celebrity category. But unlike the usual celebrity, I'm not recognizable visually. Only by name. My name means credibility. I feel I have an obligation to use my talent and my name for the widest good."

In time, doctors discovered that the Heimlich Maneuver was also a successful technique for patients suffering from asthma attacks. The maneuver expels trapped air from the lungs, clearing mucous from the airway and allowing the asthmatic to breathe normally without medication. The only difference is that less force should be used for asthma patients than for choking or drowning victims.

The success of the Heimlich Maneuver delighted Heimlich. "In a week or so, more lives can be saved by this maneuver than I can save in an operating room in my whole life," he stated. It also brought the surgeon great international acclaim, although it did not provide him with much monetary compensation. This fact did not trouble Heimlich, whose sole mission was to save as many lives as possible. "I have an unusual position in the world. I go to China, and I'm on the posters there. I go to Russia, and I'm in the newspapers there. Even in Iran or Iraq, they know about the Heimlich Maneuver. It's put me in the celebrity category. But unlike the usual celebrity, I'm not recognizable visually. Only by name," he noted. "My name means credibility. I feel I have an obligation to use my talent and my name for the widest good."

Fame Invites Controversy

Heimlich's fame did have some shortcomings. For example, demands on his time led him to discontinue performing ordinary surgical procedures. "Having gained a reputation as the country's leading esophageal surgeon, as a result of developing the esophageal replacement operation, I chose not to do the more lucrative but, to me, boring appendectomies and hernia operations," he explained. However, some colleagues felt that his decision to stop doing routine surgery was arrogant.

Heimlich's reluctance to perform ordinary surgery, as well as his opinions on controversial topics, eventually created problems at Jewish Hospital. The situation escalated to the point where he decided to leave the hospital in 1977. He accepted a position as a professor of advanced clinical sciences at Xavier University in Cincinnati. This position gave him an opportunity to found the Heimlich Institute, a research organization dedicated to the pursuit of innovative medical techniques.

Over the years, Heimlich and others at the institute continued to develop new devices and procedures to help patients. For example, they came up with a way to help stroke victims who have lost the ability to swallow. Called the "relearning swallowing process," this procedure used many of the same ideas that were applied to premature babies who did not know how to suck. Since the emergence of the relearning swallowing process, many stroke victims no longer need to be fed through a tube. Another important medical innovation attributed to the surgeon and his associates (including astronaut Neil Armstrong) was the Heimlich Micro-Trach. This device is essentially a portable oxygen system that allows patients with lung problems to transport their oxygen equipment more easily and thus lead more normal lives.

Heimlich also came up with an innovative and controversial idea for a cure for cancer. He knew that extreme heat often destroys cancer cells and prevents them from spreading. He wondered if a high fever might help a cancer patient battle the disease. Since people with malaria (a parasitic disease spread by mosquitos in tropical climates) often get high fevers, Heimlich thought that introducing malaria to cancer patients might prove beneficial. He argued that once the cancer was eliminated, the malaria could be cured easily with existing drugs. His theories were based on an earlier procedure that used malaria to battle neurosyphilis, as well as statistical data that showed that countries with high rates of malaria had low rates of cancer. In 1985, he obtained a research grant from the Fannie L. Rippel Foundation to pursue these theories.

In the early 1990s, Heimlich began conducting research about the possible use of malaria therapy to combat Lyme disease (a bacterial infection carried by deer ticks). In 1994, he traveled to China to work on a cure for AIDS (acquired immune deficiency syndrome) based on the same principles. As usual, his ideas met with resistance from the mainstream medical community. For example, Dr. Anthony Fauci remarked that "Heimlich's life-saving maneuver for people who aspirate food doesn't qualify one as an HIV expert." Dr. John Renner of the National Council Against Health Fraud stated that "After this, he won't go down in history for the Heimlich Maneuver. He'll go down in history as a bizarre, mad scientist." But Heimlich ignored such critics and continued to pursue his research.

The American Red Cross claimed that the Heimlich Maneuver was unproven in drowning cases and said that it should only be used if the rescuer suspected an obstruction in the victim's airway. But Heimlich cited evidence showing that applying the maneuver first had a 97 percent survival rate, compared to about 60 percent for traditional methods. "The only thing that bothers me is the kids that die. That's the hard thing to live with. The evidence is so sound. To save drowning victims, perform the same Heimlich Maneuver you use for a choking victim, and repeat until water no longer flows from the mouth."

In 2001, Heimlich once again found himself defending the use of the Heimlich Maneuver on drowning victims. The American Red Cross and other medical organizations directed that CPR (cardio-pulmonary resuscitation) should be the first response to drowning. They claimed that the Heimlich Maneuver was unproven in these cases and said that it should only be used if the rescuer suspected an obstruction in the victim's airway. But Heimlich repeated his assertion that his technique should be the first response. He cited evidence showing that applying the maneuver first had a 97 percent survival rate, compared to about 60 percent for traditional methods. "The only thing that bothers me is the kids that die. That's the hard thing to live with. The evidence is so sound," he stated. "To save drowning victims, perform the same Heimlich Maneuver you use for a choking victim, and repeat until water no longer flows from the mouth."

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Heimlich uses lifeguards at a swimming pool in Ohio to demonstrate how the Heimlich Maneuver can help save people from drowning, 1999.

Credited with Saving Lives

Despite the controversial nature of some of Heimlich's ideas, his record speaks for itself. The Heimlich Maneuver alone is credited with saving hundreds of thousands of lives around the world. His other innovations—such as the esophagus transplant operation, the Heimlich Valve, and the Heimlich Micro-Trach—raise the number of lives saved even higher.

Over the years, Heimlich has worked hard to raise public awareness of the Heimlich Maneuver. He wrote several books, including *Dr. Heimlich's Home Guide to Emergency Medical Situations*. He also starred in a home video entitled *Dr. Heimlich's Home First Aid Video*. He even won an Emmy award for the one-minute cartoon TV series called *H.E.L.P. (Dr. Henry's Emergency Lessons for People)*. In addition, Heimlich has made numerous appearances as a public speaker.

Ironically, Heimlich had never been called upon to perform the maneuver in an emergency setting—until just recently. In 2001, he was eating lunch at the Bankers Club in Cincinnati, Ohio, when a nearby diner began choking. Heimlich immediately rushed to his aid and performed the Heimlich Maneuver. Fortunately, the maneuver was successful and the victim recovered.

"For a long time I considered myself in left field. I thought something was wrong with me. Then, suddenly, all of my work, everything I really set my mind to, was successful. Now I have the greatest security you can have: I see that my ideas were right and all the little men were wrong. I have tremendous internal security now. I am very happy with life. Every day is better than before."

Throughout all of his endeavors, Heimlich has always tried to remain true to his principles. He states that he never would have been successful if he had listened to those who doubted him. "For a long time I considered myself in left field. I thought something was wrong with me. Then, suddenly, all of my work, everything I really set my mind to, was successful," he explained. "Now I have the greatest security you can have: I see that my ideas were right and all the little men were wrong. I have tremendous internal security now. I am very happy with life. Every day is better than before."

MARRIAGE AND FAMILY

In 1951, Henry Heimlich married Jane Murray, the daughter of famed dance instructors Arthur and Katherine Murray. Jane Heimlich has also made a name for herself in the medical community, authoring books about holistic medicine and writing a health column for the *Cincinnati Enquirer*. The couple has four children: Philip, Peter, and twins Janet and Elizabeth.

HOBBIES AND OTHER INTERESTS

Heimlich enjoys music, as well as such athletic pursuits as tennis and skiing. He is also an avid traveler. His international reputation has given him the opportunity to visit many different places across the globe.

HONORS AND AWARDS

Award from Chinese Nationalist Government: 1944
Medaglione Di Bronze Minerva (Fourth International Festival of Medical-Scientific Films): 1961
Sachs Award: 1976
Ohio State Governor's Award: 1980
Humanitarian Award (National Paramedics): 1980
Albert Lasker Public Service Award: 1984

Engineering and Science Hall of Fame: 1984
American Academy of Achievement Award: 1985
Americanism Award (China-Burma-India Veterans Association): 1988
Maimonides Research Institute Award: 1992
Safety and Health International Hall of Fame (National Safety Council): 1993

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David Ho 1952-

Taiwanese-Born American Virologist and Physician
Director of the Aaron Diamond AIDS Research Center
Named *Time* Magazine's Man of the Year in 1996

BIRTH

David Ho was born on November 3, 1952, in Taichung, Taiwan. His name at birth was Ho Da-I (in Chinese practice, the family name comes before the given name). Da-I means "Great One" in Chinese. Ho adopted the American name David when he moved to the United States in 1964. His father, Paul Ho, was an

engineer who invented software to put Chinese characters on computer screens. His mother, Sonia Ho, stayed at home to care for David and his two younger brothers, Phillip and Sidney.

YOUTH

In 1956, when David was three years old, his father immigrated to the United States. "I remember him leaving, but I don't remember what I felt about it," David recalled. Paul Ho hoped to find a job as an engineer and earn enough money to bring his family to America. For the next nine years, David and his brother Phillip remained in Taichung with their mother. They lived in a small, four-room house in a rural area surrounded by rice paddies and guava orchards. A ditch in the yard served as their toilet. The boys spent their free time playing stick ball and reading comic books. David sometimes put on puppet shows about Chinese history to entertain his younger brother.

> *"When Ho moved to America he did not speak a word of English. "It was rough at the beginning. But kids learn fast and after a three-month period, I was communicating reasonably well. After a year, it was no problem and I was managing fine. That was a real dramatic change and I would hate to have to go through that adjustment now."*

When Ho was 12 years old, he and the rest of his family finally joined his father in the United States. "We came to America with six suitcases, two for each of us," he remembered. "That was our entire fortune." They settled in Los Angeles, California, where his father was working on a master's degree in engineering at the University of Southern California. Upon their arrival, Paul Ho selected new first names for his two sons from the Bible so that they would seem more American. (David's brother Sidney was born after they came to America.)

At first, Ho felt overwhelmed by his new surroundings. After all, he had never even seen television before his family moved to the United States. "It was truly a culture shock," he noted. "Every aspect of life became different." His transition to life in America was even more difficult because he did not speak a word of English when he came to the United States. His father prohibited him from studying English in China because he did not want David to speak with an accent. He and his brother learned the language by

taking classes at school and by watching *The Three Stooges* and other slapstick comedies on television. "It was rough at the beginning," Ho admitted. "But kids learn fast and after a three-month period, I was communicating reasonably well. After a year, it was no problem and I was managing fine. That was a real dramatic change and I would hate to have to go through that adjustment now."

As Ho struggled with aspects of life that had once come easily to him, he grew determined to succeed. He worked hard to be the best in everything he did, from school to sports. "People get to this new world, and they want to carve out their place in it. The result is dedication and a higher level of work ethic," he explained. "You always retain a bit of an underdog mentality." Despite his small size, Ho became a very good basketball player. He also took up chess and won the first tournament that he entered. During college, he discovered that his mathematical skills made him an excellent gambler. In fact, he became so good at memorizing cards as they were played that he was forbidden from playing blackjack at several casinos in Las Vegas, Nevada.

"Having been a kid who did reasonably well in school, to not be able to communicate a single idea was traumatic. We hadn't even learned the ABC's. I remember being laughed at by classmates who thought I was dumb."

EDUCATION

Ho always took his education very seriously. He was expected to do well in his studies in order to follow in the footsteps of his father and other relatives who were scientists and engineers. During his early school years in Taiwan, he took extra courses after school and often ended up riding his bicycle home after dark. One time, he angrily shut himself in his bedroom after receiving a 99 on an exam. "If he got even one question wrong, he'd be very upset with himself," his mother recalled.

After leaving Taiwan, Ho completed junior high and high school in Los Angeles. He struggled in school until he developed a good understanding of English. In fact, his first American teacher recommended that he be placed in special education, but his father insisted that he be placed in a class for gifted students instead. "Having been a kid who did reasonably well in school, to not be able to communicate a single idea was traumatic," he recalled. "We hadn't even learned the ABC's. I remember being laughed at by classmates who thought I was dumb." But Ho worked hard to catch

Ho at the Aaron Diamond AIDS Research Center, 1996.

up with his American classmates. His mother sometimes found him studying in his room at two o'clock in the morning. He eventually started getting straight "A's" in every subject, including English.

Following his graduation from high school, Ho attended the Massachusetts Institute of Technology for one year and then transferred to the California Institute of Technology. He earned a bachelor's degree (B.S.) in physics with highest honors in 1974. During college, Ho became interested in the rapidly growing field of molecular biology—the study of essential molecules like nucleic acids and proteins, and their role in cell function and the transmission of genetic information. He decided to go to medical school with the intention of specializing in medical research. He earned his medical degree (M.D.) from Harvard University in 1978. "It was a typical medical school experience," he remembered. "There was a lot of work

"When the first AIDS cases appeared, Ho became fascinated with the new, unknown disease. "It was an experience I will never forget. Two young gay men with fulminant pneumonia came in. . . . We didn't know the cause but the cases looked similar. We couldn't find any literature on anything like it. It was scientifically very interesting—something new, something transmissible, and it destroys the immune system of a previously healthy person. . . ."

the first year and then the third year was spent with patients. There was an overwhelming amount of information one had to learn, and dealing with patients was a great challenge."

Seeing Some of the First AIDS Cases

To complete his training as a doctor, Ho spent three years in a medical residency program at Cedars-Sinai Hospital in Los Angeles. In 1981, he treated some of the first patients infected with HIV (human immunodeficiency virus), the virus that causes AIDS (acquired immune deficiency syndrome). At that time, no one knew what AIDS was. In fact, the disease did not even have a name yet. The patients Ho first encountered were homosexual men who were suffering from a number of serious problems that do not normally affect healthy people, like pneumonia, tuberculosis, and rare forms of cancer. It soon became clear that something had destroyed the men's immune systems (the defense mechanism that allows the body to protect itself against infections and diseases). For these men, their destroyed immune systems left them vulnerable to these opportunistic infections (infections that take advantage of a depleted immune system).

As more of these cases appeared over the next few months, Ho became fascinated with the new disease. "It was an experience I will never forget. Two young gay men with fulminant pneumonia came in. We knew they were dying, their immune systems were depleted. We didn't know the cause but the cases looked similar. We couldn't find any literature on anything like it," he recalled. "It was scientifically very interesting—something new, something transmissible [able to be passed from one infected person to another], and it destroys the immune system of a previously healthy person. Everyone thought it was only a medical curiosity; it was labeled as something truly bizarre. I had a long-standing interest in infectious dis-

eases, and I love puzzles. I was ready to look into certain diseases which lack explanations . . . and I just decided to make this new disease the focus of my research. Everyone thought I was crazy, but I decided to chase it. Like everybody else, I never thought it would be what it became."

CAREER HIGHLIGHTS

Before long, Ho and other doctors across the United States began to realize that the mysterious disease was spreading rapidly. For example, the number of cases Ho treated in Los Angeles doubled every few months. In 1982, Ho accepted a clinical and research fellowship in the infectious disease unit of Massachusetts General Hospital. Working under Martin Hirsch, a respected virologist (a scientist who studies viruses), he began trying to identify the new virus that was attacking people's immune systems. In 1983, he became the fourth scientist in the world to isolate the AIDS virus. A year later, Ho became the first scientist to find HIV in semen and in the immune cells called macrophages. In 1985, he proved that there was not enough HIV present in the saliva of infected people to transmit the virus through kissing. As the fear of AIDS became widespread, Ho's research helped clarify the ways the disease could be spread and reassure people that the disease could not be spread through casual contact.

"Everyone thought it was only a medical curiosity; it was labeled as something truly bizarre. I had a long-standing interest in infectious diseases, and I love puzzles. I was ready to look into certain diseases which lack explanations . . . and I just decided to make this new disease the focus of my research. Everyone thought I was crazy, but I decided to chase it. Like everybody else, I never thought it would be what it became."

In 1987, Ho returned to California to become an assistant professor at the University of California-Los Angeles (UCLA) School of Medicine. Three years later, however, the promising young scientist was offered a tremendous opportunity. A wealthy woman named Irene Diamond decided to create a new state-of-the-art facility dedicated to AIDS research. She asked Ho to become the founding director of the facility, called the Aaron Diamond AIDS Research Center (ADARC), when it opened in 1990 in New York City. Although Ho had made some breakthroughs in AIDS research, his

selection surprised many people. After all, he was only 37 years old at the time, and he was relatively unknown outside of his field. But Diamond had faith in Ho's energy and dedication. As director of ADARC, Ho created a world-class laboratory and filled it with 100 of the top scientists from around the world. Today, the Diamond Center is the largest AIDS research facility in the world, and it has earned an international reputation for excellence.

Changing the Way Scientists View AIDS

As the 1980s progressed and more people contracted the AIDS virus, scientists learned a great deal about HIV. They found that the virus works by targeting white blood cells known as T cells, which are a major disease-fighting weapon in the immune system. HIV attaches to and unlocks CD4 receptor proteins on the surface of the T cells. The virus then uses these proteins to replicate, or make copies of itself, and kills the T cells. When the number of T cells in the human body drops below a certain level, a person's immune system is compromised and they become vulnerable to opportunistic infections.

In the early 1990s, most scientists believed that HIV remained dormant in the human body for several years before an unknown event triggered the virus to "wake up" and attack the immune system. When this occurred, the HIV infection turned into full-blown AIDS. But Ho's research fundamentally changed the way scientists viewed the AIDS virus. During his days at Massachusetts General Hospital, Ho treated a number of gay men with severe flu-like symptoms but no sign of AIDS. The symptoms went away with treatment, and the men apparently returned to good health. A few years later, however, many of these men contracted AIDS and died. Ho began to suspect a link between the early symptoms and AIDS. When he tested gay men who showed the early symptoms, Ho found millions of HIV particles. He came up with a radical theory to explain the results of his research.

In a 1995 article published in the magazine *Nature*, Ho argued that HIV did not remain dormant in the human body. Instead, he said that the virus began replicating—making up to a billion copies of itself each day—immediately after a person became infected. But in the early stages of HIV infection, a healthy person's immune system produces millions of antibodies to counteract the effects of the virus. The immune system fights HIV to a standoff for several years, during which time the infected person remains free of symptoms. The person is said to be in a "healthy carrier state" because they test positive for the virus—and can transmit it to other

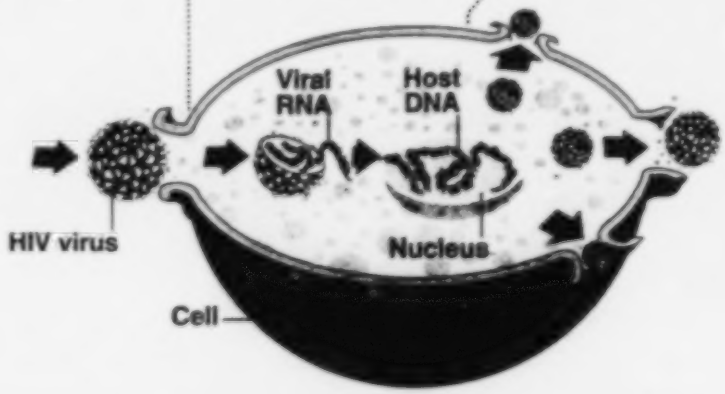
AIDS cocktail

In the mid-1990s, the advent of protease inhibitors — drugs that block the replication of the HIV virus — revolutionized HIV treatment and helped to sharply reduce AIDS fatalities. Protease inhibitors are usually combined with drugs called reverse transcriptase inhibitors to form the proverbial AIDS cocktail. Here's how the drugs work together to stem the spread of HIV within the body.

The HIV virus penetrates the wall of a cell. A virus can only reproduce inside a living cell.

Once inside the cell, the virus sheds its protein shell and releases its RNA, or its genetic material, into the cell. **Reverse transcriptase inhibitors** block this step in the process.

The viral RNA fuses with the host cell's DNA, allowing it to replicate until the cell wall bursts, releasing the virus to infect other cells. **Protease inhibitors** block this step in the process.



SOURCES: Food and Drug Administration; Ultimate Visual Dictionary of Science AP

people through sexual contact or infected blood—but they do not have physical signs of disease. Eventually, however, the immune system collapses under the strain, allowing HIV to turn into full-blown AIDS.

Shifting the Focus of AIDS Research

Ho's discovery that HIV attacks the body aggressively from the beginning caused a fundamental shift in the focus of AIDS research. Instead of treating patients after they had developed AIDS—when the situation was relatively hopeless—scientists began looking at ways to stop the infection from spreading during its critical early stages. Ho's own work in this area

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involved a new category of drugs called protease inhibitors. These drugs stopped HIV from replicating by blocking a crucial enzyme called protease. The effect was only temporary, however, because the virus quickly mutated (changed its chemical composition) and began replicating again.

Ho decided to combine several different protease inhibitors with older medications in an AIDS "cocktail" in hopes of blocking the virus from reproducing for a longer period. This form of treatment was known as Highly Active Anti-Retroviral Therapy (HAART) or combination drug therapy. "The virus can change very quickly when challenged, and you really have to attack it on many fronts," he explained. "We know how fast the virus is replicating, and how fast it will generate the mutants. If I ask it to make one mutation, it can probably do that fairly quickly. Even if I ask it to make two. I'm going to ask it to make five mutations at the same time, and that is numerically very, very unlikely. You create so many fronts for it to fight. This is the chess game we play with the virus."

In the early years of AIDS research, doctors waited until patients developed symptoms of AIDS before treating them. But Ho wondered whether combination therapy might be more effective if patients began taking the AIDS cocktail within a few weeks of testing positive for HIV. He recruited patients who had recently been diagnosed with HIV and started to study the effectiveness of the drugs. As it turned out, combination therapy dropped the level of virus in the patients' bloodstreams—known as their viral load—to a level so low that it could not be measured. In other words, the drugs helped the immune system stop HIV in its tracks. Ho was excited about the preliminary results of the study. "We basically have, for the first time, staggered the virus," he noted, "and the new optimism comes from the fact that we now realize maybe, just maybe, the virus is not as invincible as we previously thought."

Although the results of combination therapy were promising for newly diagnosed patients, Ho emphasized that it was not a cure for AIDS. The drugs could not reverse the immune system damage in patients whose infection had progressed to AIDS, and the long-term effectiveness of the drugs was not known. In addition, the drugs are highly toxic and can have serious side effects, such as nausea, vomiting, kidney pain, and liver damage. The drugs are also very expensive, which limits their availability to patients who are wealthy or have good medical insurance. Finally, undergoing the therapy requires a significant commitment on the part of patients. They must take 30 to 40 pills at specific times each day, and they must constantly monitor their viral load and T cell counts.

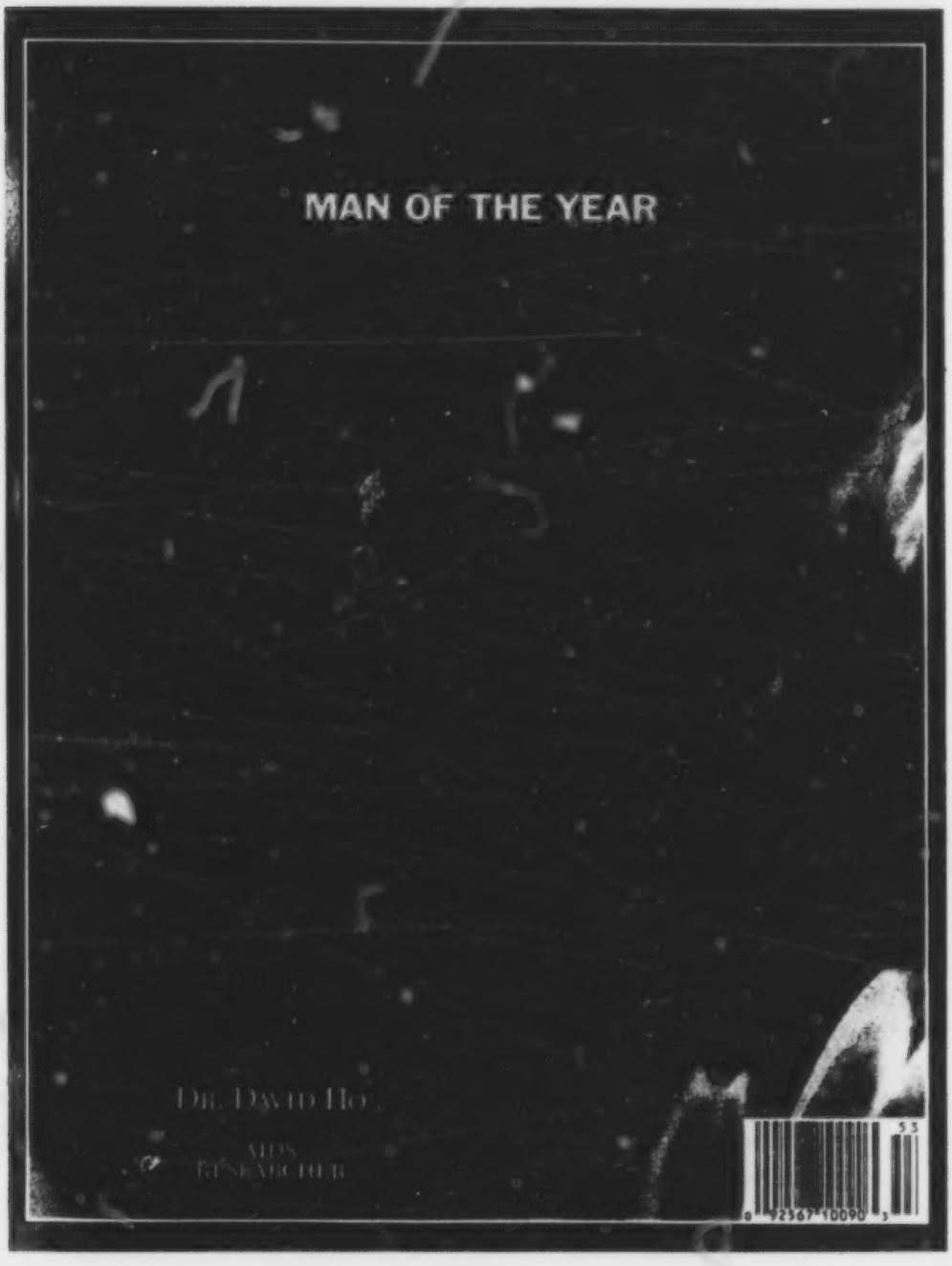
Suggesting That Early Treatment May Eradicate HIV

In 1996, Ho made headlines at the 11th International AIDS Conference in Vancouver, Canada, by suggesting that early treatment with combination drug therapy might eliminate HIV from infected patients within two to three years. He based his theory on a complicated mathematical model that charted continually declining levels of virus. If he was correct, it would be the first time scientists had ever succeeded in eradicating (wiping out) a viral infection that had already entered the human body. Ho also announced that he eventually hoped to stop using combination drug therapy on some of his patients to see whether the virus reappeared.

Ho's remarks became big news in the media. Several reporters put an optimistic spin on his message and wrote that scientists were winning the war against AIDS. But competing scientists quickly came forward to criticize Ho. They claimed that any discussion of eradicating the virus was premature and irresponsible. For his part, Ho said that his comments had been misunderstood. He claimed that his intention was only to give a scientific talk about his latest theory. "Some of the developments were blown out of proportion, even some of our work that was featured in that process," he stated. "We went and gave a very concise, limited talk on some of the theories behind eradication. In some people's minds that got translated into 'eradication.' That's not appropriate."

> ***"I think there is some hope that AIDS could be cured and that HIV could be eradicated from an infected person. I wouldn't say that's necessarily likely to happen, but I think there's a chance of that. But I am much more optimistic about controlling HIV so that the virus is stopped from doing damage to the immune system and so that you could sustain the longevity of the patient for not just a few years but for decades. That's a realistic objective. If we could get a cure, everyone would love that. But I find very few scientists who would be awfully confident about that right now."***

In any case, Ho later learned that his theory was incorrect. While early combination drug therapy could reduce the viral load to minuscule levels, it could not eradicate HIV from the bodies of infected patients. Fellow sci-



entists proved that a few copies of the virus hid in long-lived immune system cells called memory T cells. These cells keep track of all the diseases a person has been exposed to and trigger an immediate immune response when the diseases are encountered again. The action of memory T cells explains why people only get chicken pox the first time they are exposed to it. It also explains the effectiveness of the vaccines for smallpox and polio,

which work by exposing people to weakened or dead viruses in order to provoke a protective immune system response. Memory T cells exist in the body for years in a resting state, until they are finally called into action through exposure to a disease.

The fact that the AIDS virus hides in memory T cells made Ho's job much more difficult. AIDS cocktails cannot target HIV when it is hiding, and the virus can begin replicating again once the memory T cells are reactivated. Although Ho still believed that scientists might find a cure for AIDS someday, the news made him less optimistic. "I think there is some hope that AIDS could be cured and that HIV could be eradicated from an infected person," he stated. "I wouldn't say that's necessarily likely to happen, but I think there's a chance of that. But I am much more optimistic about controlling HIV so that the virus is stopped from doing damage to the immune system and so that you could sustain the longevity of the patient for not just a few years but for decades. That's a realistic objective. If we could get a cure, everyone would love that. But I find very few scientists who would be awfully confident about that right now."

Ho did not like being singled out for honors when so many scientists were making important breakthroughs in AIDS research. "I do want to emphasize that this honor should be shared with a lot of people in AIDS research: my colleagues, my collaborators, and many other researchers who laid the foundation for the success of the last couple of years."

Named Man of the Year by *Time* Magazine

In recognition of his achievements in AIDS research, Ho was named *Time* magazine's man of the year in 1996. He became the first scientist chosen for the honor in more than 20 years, and the first individual scientist ever selected (the only previous selection was a group of scientists). By that time, 300,000 people had died of AIDS in the United States, and one million were infected with HIV. A statement in *Time* said that the editors had decided to honor Ho "for helping lift a death sentence . . . on tens of thousands of AIDS sufferers, and for pioneering the treatment that might, just might, lead to a cure."

Although Ho realized that being named man of the year by a major national news magazine was a great honor, he felt uncomfortable with all

Experts predict that the AIDS epidemic could eventually kill between 100 million and one billion people, making it the deadliest disease in human history. "It has a very short history, yet has become one of the world's major killers. It has achieved the same rank as malaria and tuberculosis and is rapidly getting worse. In another ten years, it could become the major killer. It's quite important."

the attention he received. "Where most people would think of this as a cause for celebration, it's been a great source of anxiety for me," he admitted. "I'm very concerned about the hype and the publicity. One could bake in the spotlight [instead of] basking in it." Ho did not like being singled out when so many scientists were making important breakthroughs in AIDS research. "I do want to emphasize that this honor should be shared with a lot of people in AIDS research: my colleagues, my collaborators, and many other researchers who laid the foundation for the success of the last couple of years," he stated.

Over time, Ho came to view his man of the year honor as a mixed blessing. While it gave him many opportunities to spread the word about the importance of AIDS research, it also took away from his time in the laboratory. "There are wonderful benefits that occur occasionally. But with that honor comes responsibility," he noted. "I'm put in the position to help educate the public and, to some extent, the leadership about the problem. I've gotten more invitations to speak to college groups and, to some extent, high school groups. I tend to take that responsibility quite seriously. It occasionally gives me access to 'important' people and I use those opportunities to tell them about this particular problem so that it doesn't disappear from their consciousness. But if I do those things, I can't spend the time doing the research."

A Worldwide Epidemic

Despite the great strides in research made by Ho and other scientists, AIDS has continued to spread at an alarming rate. By 2001, 23 million people around the world had died of AIDS, and 40 million more were infected with HIV. An estimated 8,500 people were contracting the virus every day somewhere in the world, including 1,000 children. (Children usually contract HIV from their infected mothers, either before birth or through breast milk.) Experts predict that the epidemic could eventually kill between 100

million and one billion people, making it the deadliest disease in human history. "It has a very short history, yet has become one of the world's major killers," Ho explained. "It has achieved the same rank as malaria and tuberculosis and is rapidly getting worse. In another ten years, it could become the major killer. It's quite important."

In the United States and western Europe, public education programs have helped slow the spread of HIV significantly. In addition, advances in medical treatment have reduced the annual death rate from AIDS to one-fifth of what it used to be. But the crisis continues to grow in other parts of the world. Today, nine out of ten people infected with HIV live in developing countries, where HAART and other advanced treatments are not available. "There are close to half a dozen countries where one in four individuals is infected and certainly over a dozen [countries] where one in ten of the population is infected," Ho acknowledged. "Making combination therapy drugs available to that many people is not feasible. And it's not just a question of economics—it's also logistics. Even if the companies donated the drugs, there's no infrastructure in place that would allow them to be administered. Those who are infected in developing countries are largely doomed."

"You look at countries like South Africa, like India and China: AIDS is hardly spoken about, and yet it is a major killer. If a bomb goes off and kills ten people, it becomes a national emergency. Sixteen thousand people are doomed to die each day from HIV infection. If you want to put it in graphic terms, that's a Madison Square Garden full of people dying each day. Or several hundred jumbo jets crashing every 24 hours. Why, when you have this situation, you don't have greater national leadership is beyond me."

The main hope for stopping the spread of HIV around the world is the development of a vaccine to prevent healthy people from contracting the virus. Ho and the other scientists at the Diamond Center are actively involved in the search for an effective vaccine. "I think all of us at this institute feel that advances in drug therapy are great for American and European patients, but it's really not helping the epidemic on a global level," he explained. "Therefore, we would like to contribute to vaccine development because, I think, prevention is the key to the whole epidemic." One of the most promising areas of research involves isolating a gene that

Ho shaking hands with Chen Shui-bian, then the president-elect of Taiwan, 2000. Ho was invited by Chen as the island's top advisor in bio-technology.

seems to protect some people from HIV infection, even after repeated exposure to the virus. But developing a vaccine to prevent AIDS is very difficult. The vaccine would have to work on all ten subtypes of HIV found around the world, as well as any new mutations that might arise.

Ho frequently speaks at conferences and meets with government officials around the world to talk about slowing the spread of AIDS. He emphasizes that the leaders of developing countries need to make AIDS a priority and take an active role in the fight against it. "You look at countries like South Africa, like India and China: AIDS is hardly spoken about, and yet it is a major killer," he stated. "If a bomb goes off and kills ten people, it becomes a national emergency. Sixteen thousand people are doomed to die each day from HIV infection. If you want to put it in graphic terms, that's a Madison Square Garden full of people dying each day. Or several hundred jumbo jets crashing every 24 hours. Why, when you have this situation, you don't have greater national leadership is beyond me."

Hope for the Future

Thanks to the efforts of Ho and other AIDS researchers, testing positive for HIV is no longer regarded as a guaranteed death sentence. Combination drug therapy and other treatments are allowing many HIV-positive

people to remain healthy for years and possibly decades. For example, basketball star Magic Johnson—who disclosed that he was HIV positive in 1991—has shown no sign of the virus in his bloodstream ten years later. Ho has treated Johnson throughout that time.

Despite the impressive progress, however, Ho knows that he and his fellow scientists still have a great deal of work ahead of them to defeat AIDS. He looks forward to the challenge. "My enthusiasm is as high as ever. I think it's really fueled by the fact that we've learned so much. There's also a faith that ultimately this knowledge will translate into something practical we can use to fight the virus. I think the recent progress is the beginning of this process," he noted. "It's like putting together a building. Little by little you see a form, you can see something coming together. Most people expect one fortuitous discovery that will be the answer; that's possible, but not likely in the near future. We're seeing slow, steady progress. There are many drugs that curb the disease and maybe someday AIDS will be more of a chronic disease like hypertension or diabetes."

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MARRIAGE AND FAMILY

David Ho married artist Susan Kuo in 1976, while he was still in medical school. They live in Chappaqua, New York, with their two daughters, Kathryn and Jaclyn, and one son, Jonathan.

HONORS AND AWARDS

Ernst Jung Prize in Medicine (Jung Foundation for Science and Research)
Mayor's Award for Excellence in Science and Technology—Biological and Medical Sciences (New York City): 1993

Scientific Award (Chinese American Medical Society)
Man of the Year (*Time* Magazine): 1996
Squib Award (The Infectious Diseases Society of America): 1996
Hoechst Marion Roussel Award (American Society for Microbiology): 1999
"Bridge Builder" Asian American Leadership Award (A. Magazine): 1999
Genius Award (Asian and Pacific Islander Coalition on HIV/AIDS): 1999
U.S. Presidential Citizens Medal: 2001

FURTHER READING

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Kenneth Kamler 1947-

American Hand Microsurgeon and Mountaineer
Doctor on Several Mount Everest Expeditions
Author of *Doctor on Everest: Emergency Medicine at the Top of the World*

BIRTH

Kenneth Kamler, known as Ken to his friends, was born on October 4, 1947, in New York City. His father, William, was a lawyer, while his mother, Ethel, was a school secretary. He had one brother, Jerry, who worked as a physical education teacher before his retirement.

YOUTH

Kamler grew up in an apartment building in a section of the city known as the Bronx. Although he was interested in science from an early age, he had few natural areas to explore since he lived in the city. So he concentrated, instead, on studying slides under his microscope.

"My first climb was as an eight-year-old when I went up my father's bookshelf and pulled down a book called **Annapurna**. *It had such a funny title, I couldn't imagine what it was about. It turned out to be a classic mountaineering tale of the ascent of what was at the time the highest mountain ever climbed. I don't know what my father was doing with that book—no one around me had ever spoken about mountain climbing, much less actually done it—but the book opened up for me, at an impressionable age, a world I never knew existed, impossibly far away from my apartment house in the Bronx."*

Kamler first became interested in mountaineering at the age of eight, when he was captivated by a book on the subject. "My first climb was as an eight-year-old when I went up my father's bookshelf and pulled down a book called *Annapurna,*" he recalled in his book *Doctor on Everest.* "It had such a funny title, I couldn't imagine what it was about. It turned out to be a classic mountaineering tale of the ascent of what was at the time the highest mountain ever climbed. I don't know what my father was doing with that book—no one around me had ever spoken about mountain climbing, much less actually done it—but the book opened up for me, at an impressionable age, a world I never knew existed, impossibly far away from my apartment house in the Bronx."

Kamler's parents enjoyed traveling, so he had the opportunity to visit several countries around the world during his childhood. Although he appreciated being exposed to cities like London and Paris, he longed to explore more remote areas. "As I got a little older, traveling with my parents suddenly wasn't 'cool' anymore," he explained. "We were going to ever more exotic countries, but if the sights were listed in a guidebook they lost their appeal for me. It was the secret places I didn't want to miss out on."

EDUCATION

Kamler attended the Bronx School of Science, graduating from high school in 1964. He then attended Queens College in New York, where he earned a bachelor's degree in biology in 1968. He continued his education by attending medical school in southern France at the University of Marseille. It was during this time that he met and married his wife, a Frenchwoman named Josiane. In 1975, Kamler completed medical school and earned his degree as a medical doctor (M.D.). He then returned to New York and served as a resident in orthopedic surgery at Long Island Jewish Hospital. He continued his medical training with a fellowship in hand microsurgery at Columbia Presbyterian Hospital in New York City.

CAREER HIGHLIGHTS

Upon completing his education, Kamler became a prominent hand surgeon. He maintained a busy private practice as director of the Hand Treatment Center in New Hyde Park, New York. He was also called upon to treat emergency cases in nearby hospitals. "I treat a lot of athletes who have injuries," he noted. "A lot of people who work in factories with machines injure their hands. And I also take care of a lot of people with rheumatoid arthritis or a lot of kids who are born with malformed hands."

Although Kamler found his work as a doctor fulfilling, he continued to feel a desire to explore strange lands. In addition, he maintained the strong interest in mountaineering that had formed during his childhood. In 1979, he finally got a chance to make his lifelong dream of mountain climbing a reality. He had planned to take a two-week vacation with his wife, but she had to go to France unexpectedly because her father was ill. Kamler suddenly found himself with some free time and decided to use it to try mountaineering. "There is nothing as real as a dream, and if you hold on to it it will always be there no matter what else changes," he explained. "In my mind, I climbed back up the shelf and dusted off that old book. After so many years of thinking it was inaccessible, I made a bridge from one world to another with a phone call—to a climbing school in New Hampshire."

Kamler took a two-week course in climbing techniques and formed a close friendship with his instructor. Six months later, the instructor invited him along on a climbing trip to Peru. This fateful journey led to Kamler's second career—as an expedition doctor on mountaineering trips around the world. As they were traveling through a remote area on their way to the base of the mountain they planned to climb, Kamler and his instructor witnessed an accident. A truck went off the winding road and tumbled

Kamler examining a Sherpa at base camp on Mount Everest at 17,500 feet.

down a cliff. Kamler was the only person within miles who could give medical attention to the accident victims. He stabilized them for the trip to the nearest clinic, but he soon found that the doctors there were not equipped to deal with their injuries. So he remained with the victims and cared for them until they could be evacuated to a city hospital.

The story of Kamler's dramatic rescue of the accident victims became big news. It led to an invitation for him to join the Explorers Club, a professional society dedicated to scientific exploration and research. As a member of the club, Kamler had many new opportunities to take part in expeditions around the world, from the jungles of the Amazon to the frozen tundra of the Arctic. He also served as the doctor for several expeditions to climb Mount Everest.

Climbing Mount Everest

Located in the Himalayas along the border between Tibet and Nepal, Mount Everest is the highest mountain in the world. The summit, at 29,028 feet above sea level, is about the same altitude at which commercial jets fly on long-distance flights. For many years, it was believed that the mountain was too big to climb. But after several other attempts failed, Sir Edmund Hillary of New Zealand and Sherpa Tenzing Norgay of Nepal finally

reached the summit of Mt. Everest in 1953. (For more information on Hillary, see *Biography Today*, Sep. 1996.) Since then, more than 700 people have reached the top of the mountain, although many others have died trying. The high altitude and extremely cold and windy conditions on Mt. Everest can cause severe physical problems for climbers. For example, Kamler noted that the air high on the mountain contains only about a third as much oxygen as the air at sea level. "Your body can't burn fuel efficiently at that height," he explained. "So your metabolism is sort of like smoldering instead of burning and you can't give yourself enough energy."

Since 1993, Kamler has taken part in six expeditions to climb Mt. Everest. On one expedition, he helped map parts of the mountain for *National Geographic*. In 1998, as a member of the Everest Extreme Expedition, he helped test medical equipment for the National Aeronautics and Space Administration (NASA). Kamler and other team members attached high-tech sensing equipment to four professional climbers and monitored them from base camp while they made a summit attempt. "NASA had been developing remote-sensing devices to use for astronauts on the moon or in a space station," he recalled. "They're going to have people out there who will not be able to get medical care—at least not directly, so they developed these devices which could be worn on the body which would monitor blood pressure, pulse, respiration, body temperature." The scientists at NASA decided to test their equipment on Mt. Everest because they noticed a number of similarities between the high-altitude environment and space. The remote-monitoring devices enabled Kamler to track the climbers' exact position and to determine whether their physical condition made it safe for them to continue climbing.

"The high altitude and extremely cold and windy conditions on Mt. Everest can cause severe physical problems for climbers, including a lack of oxygen. "Your body can't burn fuel efficiently at that height. So your metabolism is sort of like smoldering instead of burning and you can't give yourself enough energy."

Doctor on Everest

Kamler has treated many climbers during his various expeditions to Mt. Everest. Many of his patients have suffered injuries, including fractured

skulls, broken bones, and dislocated joints. Others have experienced problems due to the extreme altitude and cold, such as lung infections, brain swelling, and frostbite. "I spend far more time taking care of people than climbing," he admitted. "I'm usually there two to three months, and I would treat maybe 100 people. There is a lot of high-altitude illness, such as pulmonary and cerebral edema [swelling of the lungs and brain caused by fluid buildup]. I also treat a lot of frostbite, snow blindness, diarrhea, bruises, falls, sprains, strains, broken bones, and dislocations."

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Because of the remote location of Mt. Everest, Kamler must treat all of these conditions—some of which can be life-threatening—using only the medical supplies he brings with him to the base of the mountain. "The challenge of packing medicine is daunting, if you don't take it one step at a time," he explained. "So I try to think of every injury I might encounter and every problem I might run into, then I list every supply I would need for it, from cardiac stimulants to adhesive tape. Because if I don't bring it, I don't have it and I have no chance of getting it."

The typical method of climbing Mt. Everest requires climbers to make repeated trips to a series of camps located at higher and higher elevations over the course of several weeks. This strategy allows climbers to adjust gradually to higher altitudes. Many of the cases of high-altitude illness Kamler treats occur when climbers try to ascend too quickly. As the expeditions work their way higher on the face of Everest, however, the amount of medical supplies he can bring with him is further limited. "I start at base camp with about four yak loads of supplies, but by Camp 2, which is 4,000 feet higher, I'm reduced to just a fishing tackle box worth of equipment," Kamler noted. "And then higher than that, I just take what I can put in a plastic bag and keep inside my pocket."

Kamler examining a Sherpa for snow blindness at Camp 2 on Mount Everest at 21,000 feet.

In addition to the problem of limited medical supplies, Kamler must also deal with his own physical limitations when treating patients at high altitudes. "I'm called upon to make some critical medical decisions which are complicated enough in a modern hospital intensive care unit, and I'm often in a situation where I'm not getting enough oxygen myself and it's very cold and the cold is sort of debilitating as well," he stated. "So you often have a situation where it's hard to think clearly, and sometimes it's literally confusing to figure out how to tie your shoes, much less make difficult medical decisions."

When treating patients at high altitudes, Kamler says, "I'm called upon to make some critical medical decisions which are complicated enough in a modern hospital intensive care unit, and I'm often in a situation where I'm not getting enough oxygen myself and it's very cold and the cold is sort of debilitating as well. So you often have a situation where it's hard to think clearly, and sometimes it's literally confusing to figure out how to tie your shoes, much less make difficult medical decisions."

Although Kamler has attempted to reach the summit of Mt. Everest himself, his role as expedition doctor has prevented him from attaining his goal on several occasions. "I haven't summited Everest but I still feel very rewarded with my experiences on Everest because I've taken care of a lot of people on the mountain," he noted. "I still get these letters and things from people that I've helped." The closest Kamler ever came to the summit was in 1995, when he turned around just 900 feet from the top after encountering chest-deep snowdrifts. "I was only 900 feet below the summit, but I turned back because I felt conditions at that point were too dangerous," he recalled. "That's 900 feet on a 29,000-foot mountain. Had I continued on and made the summit, it would have probably only taken another hour. And this was after a two-month expedition. [I decided that] what I had waiting for me at home was far more important than the top of the mountain."

Treating Victims of the 1996 Disaster

Kamler was serving as a doctor on an Everest expedition on May 10, 1996, when the worst disaster ever to occur on the mountain took the lives of eight climbers. It started out as a beautiful day for climbing, and a record

Kamler examining a case of severe frostbite at Camp 2 on Mount Everest at 21,000 feet.

number of people attempted to reach the summit. Many of these people were relatively inexperienced clients who paid professional mountaineering guides to assist them. Until recently, virtually everyone who attempted to climb Everest was a very experienced climber. But the 1990s saw an increase in the popularity of guided expeditions, in which wealthy clients would pay expert mountaineers as much as $65,000 per person to guide them to the top of Everest. On that tragic day in 1996, a record number of climbers created traffic jams along the treacherous route to the summit, causing the passage to take hours longer than usual. In the meantime, a terrible storm blew in and trapped 13 people near the top of the mountain. The combination of weather conditions and high altitude made the situation extremely dangerous for these climbers.

When the storm began, Kamler was at Camp 3, located at an altitude of 24,000 feet. A group of fellow climbers called him on the radio from Camp 4, located 2,000 feet above, to tell him about the situation. Over the next few hours, rescuers managed to find several of the missing climbers, but some of them were in critical condition. Since he did not have adequate supplies to treat the critical cases at Camp 3, Kamler decided to descend

3,000 feet to Camp 2 and set up a makeshift medical clinic. The strongest climbers from his expedition risked their own lives to bring the victims down the mountain so Kamler could treat them.

The worst case Kamler saw was an American climber named Seaborne (Beck) Weathers. Weathers had somehow managed to survive the night in the open near the summit, but he had suffered terrible frostbite and was barely clinging to life. "When we first heard about Beck, we heard that he was dead," Kamler recalled. "That was our first report. He had been found in the snow at Camp 4 and pronounced dead. And our rescuers were tending to the other ones who were still alive when Beck just suddenly appeared out of the white-out, out of a swirling fog, and just staggered into camp."

"Each year I go [to Everest] people die on the mountain. So the idea of death on the mountain is not new to me or to any other big-mountain climber. We've all seen it and we've all accepted it, otherwise we wouldn't be doing it. The route up Everest has dead bodies on it, so there's no way that you don't know that that's a possibility. You're reminded of it all the time."

Kamler was surprised at Weathers's positive mental state, despite his terrible injuries. "When I caught up with him at Camp 2, I expected an incoherent, half-conscious phantom, but he walked into the tent and he said, 'Hi Ken, where should I sit?'" the doctor remembered. "He was really very well-oriented, much better than I expected. So we laid him down on the mat and on the sleeping bag and we started an IV. And I started to examine him. He had the worst frostbite I've ever seen and I've seen quite a bit of frostbite."

Even though Kamler managed to stabilize Weathers' condition, he knew that the injured climber could not survive another night above 20,000 feet. Kamler and other healthy climbers then began a dangerous descent back to base camp. Once they had gone down about 2,000 feet, the weather cleared sufficiently for a helicopter to land near the group. In a dangerous maneuver, the helicopter picked up Weathers and evacuated him to a hospital in the nearest city, Kathmandu. Although he lost most of both hands and part of his nose to frostbite, Weathers survived his ordeal and returned to his family in the United States. Kamler later told the story of the rescue in his book *Doctor on*

Kamler crossing a crevasse in the icefall on Mount Everest.

"I like the idea of reducing life to its simplest, most basic elements. Food, shelter, and survival. That's how people are made to live. Climbing doesn't fill you up with the trivial stuff that everyday life has too much of. It sharpens your senses. It makes life more intense. So I find that very satisfying. And then, the risk itself in climbing is actually attractive. I like the idea of taking a risk where you're in control. . . . You really take control of yourself and it brings out qualities that you might not even know you have. It really pushes you to the limit and you see what you're made of. It just sharpens life for you."

Everest: Emergency Medicine at the Top of the World, which was published in 2000. The disaster also served as the subject of journalist Jon Krakauer's best-selling book *Into Thin Air,* as well as an IMAX film called *Everest.* (For more information on Krakauer, see *Biography Today Authors,* Vol. 6.)

Continuing to Climb Despite the Risks

Kamler's firsthand involvement in the 1996 disaster did not discourage him from making future trips to Mt. Everest. "Each year I go people die on the mountain," he explained. "So the idea of death on the mountain is not new to me or to any other big-mountain climber. We've all seen it and we've all accepted it, otherwise we wouldn't be doing it. The route up Everest has dead bodies on it, so there's no way that you don't know that that's a possibility. You're reminded of it all the time."

Kamler discussed some of the factors that make him continue climbing, despite the risks: "I like the idea of reducing life to its simplest, most basic elements. Food, shelter, and survival. That's how people are made to live. Climbing doesn't fill you up with the trivial stuff that everyday life has too much of. It sharpens your senses. It makes life more intense. So I find that very satisfying. And then, the risk itself in climbing is actually attractive. I like the idea of taking a risk where you're in control. . . . You really take control of yourself and it brings out qualities that you might not even know you have. It really pushes you to the limit and you see what you're made of. It just sharpens life for you."

Kamler has always been interested in exploration. As a doctor, he is particularly interested in the effects of extreme environments on the human

body. "Humans have sailed all the seas, climbed the highest mountains, dived the deepest ocean abysses, and landed on the moon. Yet the most exciting time to be an explorer is just beginning. The routes have been opened to bring the very edge of science to the most remote regions on earth and beyond," he stated. "Possibilities now seem boundless, but ironically, the device that generates the drive to explore—the human mind—is limited in its ability to explore by its container, the human body. As a doctor this is the area of exploration that interests me most. Humans have the ingenuity to enter the most extreme environments and the temerity [nerve] to think they can survive there. But their bodies are far more fragile than they would like to admit." Kamler adds that new technologies "have allowed exploration of the most hostile areas, but medical science has not yet found cures for the diseases that these environments inflict on human bodies when their artificial protections break down."

Although Kamler believes that scientific exploration is important, he remains concerned about the effect it has on the remote areas of the world. "The greatest danger is not to ourselves but to our environment," he remarked. "By its very nature exploration irrevocably changes what it discovers. Environments become contaminated, cultures become homogenized. With easier and more frequent access for explorers and scientists carrying ever more sophisticated equipment, the remote regions are in danger of being destroyed before they are understood. The greatest era of exploration is yet to come, but only if we take care of our wild places even as we unlock their mysteries."

MARRIAGE AND FAMILY

Kamler met his wife, Josiane, while he was attending medical school in France. "One sunny day a girl called me up because she heard there was an American around and she wanted to practice her English," he remembered. "Josiane was cute, smart, sensitive, and strong—a rare combination, so I married her." Josiane is also trained as a doctor, but she put her career aside in order to care for their two children, Jonathan and Jennifer. Although she worries about her husband when he goes off on expeditions, she is very supportive of his mountaineering. "She'd certainly prefer that I had another hobby, but she understands that it's important to me," Kamler explained.

WRITINGS

Doctor on Everest: Emergency Medicine at the Top of the World, 2000

FURTHER READING

Books

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WORLD WIDE WEB SITES

http://www.explorers.org/newsfiles/archivefiles/kamlerinterview.html
http://www.usatoday.com/life/everest/ever007.htm

Lucy Spelman 1963-

American Veterinarian
Director of the National Zoo in Washington, D.C.

BIRTH

Lucy Hamilton Spelman was born on January 8, 1963, in Bridgeport, Connecticut. Her father, James, was a merchant who ran upscale toy stores until he died recently of heart disease. Her mother, Mary, is an author who has written several young adult novels under the name Mary Towne and two adult novels under the name Mary Lockwood. Lucy was the second of three children. She has one brother and one sister.

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YOUTH

Spelman grew up in West Redding, Connecticut, on 14 acres that used to be a dairy farm. Her family always had lots of animals, including dogs, cats, horses, goats, guinea pigs, rabbits, and parakeets. Lucy loved the animals and handled most of their care and feeding herself. Her mother recalled that when they first got a baby goat, it refused to drink from a bottle. Her father wanted to return it, but Lucy talked him out of it. "She persuaded him to go back and buy the mother," Mary Spelman remembered. "She was determined to have those goats."

"I remember just always wanting to be a zoo or wildlife vet. Certain people are animal people. For me, it's the fascination with the fact that we have so many diverse creatures that live in different places and are adapted to different things. That's just amazing to me."

As a girl, Spelman's favorite television program was the nature series "Wild Kingdom." Every week, she tried to convince her family to watch it with her in the living room. But her parents and siblings always wanted to watch "Star Trek," which was broadcast at the same time. So Spelman ended up watching her show in the unheated basement of their house. "I was the lone holdout," she recalled. "The basement was really, really cold."

Spelman enjoyed tennis, drawing, and playing violin during her youth. But animals were always her main focus. She read books by British veterinarian James Herriot, the author of *All Creatures Great and Small,* and decided to become a veterinarian herself. "I remember just always wanting to be a zoo or wildlife vet," she noted. "Certain people are animal people. For me, it's the fascination with the fact that we have so many diverse creatures that live in different places and are adapted to different things. That's just amazing to me." (For more information on Herriot, see *Biography Today Authors,* Vol. 1.)

EDUCATION

Spelman was a good student throughout her school years in West Redding. She credits her fourth-grade teacher, Anne Marshall, with fueling her interest in math and science. Marshall's class had "old clothes Wednesdays," where the students would wear clothes they could get dirty and spend the afternoon at a local nature preserve. "That's where I made the

connection that science and math are part of understanding nature," Spelman explained.

Spelman went to college at Brown University, earning a bachelor's degree (B.S.) in biology in 1985. She continued her education at the University of California at Davis, completing her doctor of veterinary medicine degree (D.V.M.) in 1990. After finishing her veterinary degree, Spelman applied to the zoological medicine residency program at the North Carolina State College of Veterinary Medicine and the North Carolina State Zoological Park. This program is unique in that it allows new veterinarians to study animals at the university, at the zoo, and in the wilderness. As a result, the residency is so competitive that sponsors choose one person each year out of 30 to 50 qualified applicants. Spelman was accepted into the program and spent three years there. During her residency, she completed a special research project on North American river otters. Upon completing the program, she became one of only 60 board-certified zoological veterinarians in the world.

CAREER HIGHLIGHTS

Zoo Veterinarian

In 1995, Spelman took a job as an associate veterinarian at the Smithsonian Institution's National Zoological Park, commonly known as the National Zoo, in Washington, D.C. She soon became known for her skill in anesthetizing animals (injecting medication to make them unconscious for surgery or other medical procedures). "It's a challenge to do it quickly and smoothly and get it done right the first time," she noted. "I'm quick with the darts and a really good shot."

In September 1999, Spelman was promoted to chief veterinarian at the National Zoo. In this position, she directed the medical care of all the animal residents of the zoo. Unusual encounters with animals were a daily part of her job. For example, she once treated a crocodile that had swallowed a garden hose. Another time, a tiger that was under anesthesia for a dental procedure accidentally bit all the way through her hand. After a while, some of the animals began to associate Spelman with unpleasant things, like getting shots. They would recognize her scent as she drove by in her special golf cart and scurry off to hide. A few animals reacted more strongly to her presence. For instance, one of the gorillas had a habit of throwing poop at her. Whenever Spelman treated the gorilla, she tried to remember "to keep my mouth closed and wear a mask."

Director of the National Zoo

In June 2000, Spelman was named director of the National Zoo. She thus became the youngest person (at 37) and the first female to direct the zoo, and one of only a handful of women to head major zoos in the United States. Her appointment as director of the zoo came as a surprise to many people. After all, she had only worked at the zoo for five years, and she had very little administrative experience. In fact, Spelman did not even apply for the job until she was asked to by the head of the search committee at the Smithsonian. But people who knew her predicted that she would emerge as a strong leader in her new role. The Smithsonian board explained that they had selected Spelman because of her compassion for animals and her skill in dealing with people.

As director of the National Zoo, Spelman supervises a staff of over 300 people and controls an annual budget of more than $26 million. She also oversees maintenance of the 163-acre facility and care of 3,500 animals belonging to 475 different species. In addition, she must give speeches, take part in fundraising events, provide tours for important people, and make plans for the future of the zoo. Finally, she has to make sure that the three million people who visit the zoo each year have a good experience and learn about animals. Taking charge of these responsibilities has made Spelman a role model for many young women. "Being a woman and get-

ting this job has never occurred to me, but I'm happy to build on the fact that I am relatively young, I am female and dedicated, and hope that will motivate people to follow their dreams," she stated.

Spelman has already come up with a number of ideas for improving the zoo. For example, she wants to rebuild some of the enclosures to allow the animals to live in more natural conditions and to give the visitors a better view. She also wants to reorganize some of the exhibits so that different areas of the zoo will feature animals from certain geographic regions of the world. Another plan for the future involves building a children's farm in order to introduce kids to domestic animals. "Plenty of urban children have never seen a cow, let alone a zebra," she explained. Spelman also hopes to expand the preventative medicine program she established when she was chief veterinarian, so that more animals will receive an annual physical examination. Finally, she would like to increase the number of annual visitors to four million per year and improve the zoo's fundraising.

Becoming director of the National Zoo has made Spelman a role model for many young women. "Being a woman and getting this job has never occurred to me, but I'm happy to build on the fact that I am relatively young, I am female and dedicated, and hope that will motivate people to follow their dreams."

As a way to increase interest in the zoo and reward people who donate money, Spelman plans to expose more people to what she calls the "hidden zoo." "There is so much that goes on behind the scenes. There are people who trim trees and people who chop food for the tamarin monkeys. There are even scientists who study animal reproduction and behavior. It's more than just what people see on the outside," she noted. "In my new job, I've pledged that if I'm involved in a clinical procedure, I'm going to make an effort to show someone that procedure, whether it's the press or . . . a donor or someone from the Smithsonian. I want to find a way to tell people about what goes on behind the scenes. The zoo isn't just about the exhibits."

Caring for Giant Pandas

The best-known residents of the National Zoo are probably the giant pandas. The zoo received its first two giant pandas from the government of the People's Republic of China in 1972. At that time, the United States and

China had been estranged for 21 years. But then President Richard Nixon made his historic 1972 visit to China and opened up diplomatic relations between the two nations. The Chinese government then made a gift to the U.S. of the giant pandas, which are found only in the forests of western China. Giant pandas are endangered animals—they are in grave danger of extinction. Only about 1,000 animals remain in the wild, and about 100 now live in zoos around the world.

The pair of pandas that came to the National Zoo in 1972, named Ling-Ling and Hsing-Hsing, were the first ones to live outside of China. More than 20,000 people came to see them on their first day at the National Zoo. Over the years, they became symbols of international friendship and conservation. Countless Americans followed the pair's attempts at breeding, although sadly, none of their five cubs lived more than a few days. Americans mourned the death of Ling-Ling from heart failure in 1992.

Hsing-Hsing remained at the zoo when Spelman arrived in 1995, and she helped care for him over the next few years. In 1999, Hsing-Hsing was diagnosed with kidney failure. This was a natural result of his old age. The panda was 28 years old—the equivalent of about 80 in human years—while pandas in the wild typically only live to about 15. For sev-

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eral months, Spelman gave Hsing-Hsing medicine to treat his condition and help make him comfortable. She felt that it was important for as many people as possible to see the panda and think about the possibility of the species' extinction. "Every day that he feels well," she stated, "visitors can appreciate a unique species and can think about where did that animal come from? Do we want that habitat to still exist? How can we help that? He's taught us a lot. His long life span reflects the quality of care he's had here. Everything from his diet to his exhibit and now his geriatric medicine."

Spelman felt that it was important for as many people as possible to see the aging panda Hsing-Hsing and think about the possibility of the species' extinction. "Every day that he feels well, visitors can appreciate a unique species and can think about where did that animal come from? Do we want that habitat to still exist? How can we help that? He's taught us a lot. His long life span reflects the quality of care he's had here. Everything from his diet to his exhibit and now his geriatric medicine."

By November 1999, however, Hsing-Hsing had trouble moving around and could not recognize his keepers. As chief veterinarian, Spelman had the difficult job of putting the zoo's best-known and best-loved animal to sleep. "That was tough. Not because it wasn't the thing to do. It was the right thing to do at the time. But that animal was an amazing animal, and he had touched so many people's lives," she stated. "Tears were flowing. But I was on a mission—to make sure he didn't suffer a day on this planet."

Bringing New Pandas to the Zoo

In 2000, as director of the National Zoo, Spelman helped arrange for the zoo to acquire two new giant pandas from China. She helped raise millions of dollars from the U.S. government, the Smithsonian, corporations, and private donors in order to lease the animals from the Chinese government at a cost of $1 million per year for ten years. Under the contract, China must put most of the lease money toward projects aimed at preserving the panda and its habitat. The National Zoo also spent $3 million to upgrade its facilities for the new pandas. They built sloping gardens, sand wallows, ponds, and cool-air caves, plus added trees for shade and

climbing. "We've renovated all of the spaces, adding rockwork and waterfalls and trees, because, of course, these are youngsters, and we want to encourage them to explore and play and climb, and really do their natural behaviors," Spelman explained. "We want this to be a 'wow' exhibit."

In December 2000, Spelman and several other zoo representatives traveled to China and brought home the two new pandas—Mei Xiang, a 2-year-old female who weighed 115 pounds, and Tian Tian, a 3-year-old male who weighed 200 pounds. After a short adjustment period, they went on exhibit at the zoo in January 2001. About two million people had come to see them by August of that year. Mei Xiang and Tian Tian also became the subjects of a documentary television special called "Meet the Pandas: Washington's New Power Couple" that aired on the Animal Planet network. "Few species have a greater public impact, or greater public appeal, than the giant panda," Spelman stated. "We must also learn more about giant pandas quickly, while there is still time, in order to develop and implement a successful long-range plan for their conservation in the wild."

"The intent of the zoo's research program is to try to generate as much additional information as possible about the giant panda that can be used to help ensure its survival in the wild. There are still a lot of basic questions we don't know the answers to about the giant panda. That's because there are so few to study."

With this goal in mind, Spelman and her colleagues at the zoo designed a number of research projects around the pandas. They hope to learn more about their preferences in food and surroundings, as well as ways to reduce their stress levels in captivity and to reintroduce captive bears to the wild. "The intent of the zoo's research program is to try to generate as much additional information as possible about the giant panda that can be used to help ensure its survival in the wild," Spelman noted. "There are still a lot of basic questions we don't know the answers to about the giant panda. That's because there are so few to study."

One of the most interesting subjects of research involves the mating habits of pandas. Pandas do not usually begin breeding until they are between four and eight years old, and female pandas can only become pregnant a few days each year. These factors make it difficult for the animals to breed

Female panda Mei Xiang at the National Zoo, January 2001.

successfully in captivity. "We would love it if they would breed," Spelman said of the new pandas. "What we've learned from our Chinese colleagues suggests that socializing them young this way, having them together, gives them the best chance of being a successful breeding pair."

Working Hard and Loving Her Job

Spelman puts in long days as director of the National Zoo, sometimes working as many as 16 hours per day. She always wears a high-tech pager with a keypad so she can take notes as she makes her way around the zoo. Despite the hectic pace, however, Spelman loves her job. "I have the ability to truly appreciate how amazing animals are," she explained. "From a distance it might be hard to appreciate just how powerful the jaws on a tiger are, how intricate a cheetah pattern is, and how long the neck of a giraffe is. I get to see it all up close."

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In addition to her work at the zoo, Spelman is an adjunct professor at the Virginia-Maryland Regional College of Veterinary Medicine. She says that she is devoted to teaching other veterinarians because "you can't learn zoo medicine from a book." Spelman also continues to pursue research projects of her own. She has published scientific papers on a wide variety of subjects, including treatment techniques for cheetahs, otters, and Komodo dragons. She is also known as leader in geriatric medicine (treatment of the symptoms and diseases of aging), which is important because animals tend to live longer in zoos—where they receive better care and nutrition—than they do in the wild.

Some people dislike zoos because they feel it is cruel to keep wild animals in captivity. But Spelman disagrees with this idea. "For people who say keeping animals in a zoo is cruel, I tell them to go to animal shelters and see animals that are the product of short-term desire. There are a large number of animals out there that have a less-than-ideal life, and I think that most zoos have an incredible standard for their animals," she stated. "We need to dispel the notion that we've just taken the animals out of the wild and caged them. Almost all the animals in the zoo were born in zoos. I understand the passion behind the animal rights movement. I just wish we could channel it so we could work together on conservation."

In fact, Spelman believes that zoos play an important role in helping to preserve endangered species and wildlife habitat. "The zoo has a critical role in a diverse world. It's about plugging into the global conservation effort. We are supporting active research and education. It's about more than just the creature," she noted. "If we can make a place where [people are exposed to the wild], then I think we can help keep the idea alive that we might want to maintain areas of our world that have plants and animals."

Spelman never expected to be the director of one of the most prestigious zoos in the United States at this early point in her career. She hopes that her own experience will inspire young people to work hard to achieve their dreams. "If you really want to do something then you can do it. It doesn't matter if you are a boy or a girl. Look around. There are plenty of girls and women doing amazing things. Don't worry if you don't follow the traditional way of doing something. Stay with it!" she stated. "I haven't

"If you really want to do something then you can do it. It doesn't matter if you are a boy or a girl. Look around. There are plenty of girls and women doing amazing things. Don't worry if you don't follow the traditional way of doing something. Stay with it! I haven't followed any kind of typical path to this point, so I'm not going to worry about the fact that I don't know how it's going to pan out. I love what I do. I think this is a great place and I'm just going to go with it. There's never a dull moment. That's my motto."

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HOME AND FAMILY

Spelman lives in a one-bedroom loft apartment in the Glover Park neighborhood of Washington, D.C. Among the decorations in her home is a framed elephant footprint and a painting by an orangutan. Spelman shares her home with two Labrador retrievers, a yellow one named Tucker and a black one named Kelby. She manages to sneak out of the zoo to walk her dogs every day at lunchtime. They are always very interested in the animal smells she brings home on her clothing. "Dogs are all about smell," she noted. "Tucker and Kelby are very aware I've been somewhere way interesting."

Spelman has never been married and says that she is comfortable with her single lifestyle. She claims that she could only enter a serious relationship with someone who understood her commitment to animals and to her job. "I'm definitely not going to be easy to package. I've never wanted to change my path," she explained. "That person would have to have a feel for my connection to the animal world. That's what makes my life richer. There aren't a lot of people as passionate about that as I am."

HOBBIES AND OTHER INTERESTS

In her limited spare time, Spelman enjoys watercolor painting, bird watching, tennis, golf, hiking, bicycling, and eating vegetarian dinners with friends.

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FURTHER READING

Periodicals

Chicago Tribune, July 10, 2000, p.C2
New York Times, Jan 11, 2001, p.A21; Apr. 17, 2001, p.F1
People, June 25, 2001, p.133
Richmond Times Dispatch, Aug. 13, 2000, p.G1
Seattle Times, July 22, 1999, p.A1
Smithsonian, Dec. 2000, p.12
Washington Business Journal, May 25, 2001, p.32
Washington Post, Aug. 1, 1999, p.C1; Nov. 29, 1999, p.A1; June 20, 2000, p.B1; Aug. 12, 2000, p.C1; Aug. 19, 2000, p.A1; Sep. 23, 2000, p.B1; Dec. 4, 2000, p.B1; Jan. 7, 2001, p.C1; Apr. 6, 2001, p.C1; May 7, 2001, p.A1; June 22, 2001, p.A1

ADDRESS

National Zoological Park
3001 Connecticut Avenue NW
Washington, DC 20008-2537

WORLD WIDE WEB SITES

http://www.natzoo.si.edu
http://www.girlpower.gov/girlarea/gpguests/spelman.htm
http://www.brownalumnimagazine.com

Lydia Villa-Komaroff 1947-

American Molecular Biologist and Educational Administrator
Part of the Research Team That First Produced Insulin from Bacteria

BIRTH

Lydia Villa was born on August 7, 1947, in Las Vegas, New Mexico. She grew up in Santa Fe. Her father, John Vias Villa, was a teacher of music, math, and English, as well as a violinist with the Santa Fe Orchestra. Her mother, Drucilla (Jaramillo) Villa, was a teacher and social worker. Lydia was the oldest of

six children in her family. She has three brothers, Richard, Roland, and Lorenz, and two sisters, Kathryn and Dorthea.

YOUTH

Villa-Komaroff, as she has been known since she got married in 1970, has Hispanic roots on both sides of her family. Her mother's ancestors came to North America with the Conquistadores (Spanish soldiers who conquered the Indian tribes of Mexico in the 1500s) and settled in Arizona. Her father's family lived in Mexico and was descended from both Spanish and indigenous Indian people. Both of her parents were the first members of their families to go to college. As a result, they placed a high value on education and expected their children to work hard in school.

Although Villa-Komaroff's family was not wealthy, her parents always made sure that she and her siblings had food to eat and books to read. "I remember when I was five [my father] brought home the *World Book Encyclopedia,* and he said that everything I wanted to know was in those books," she recalled. "I was very excited by that notion. He bought the books and my mother read to us—that's one of my earliest and warmest childhood memories."

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Villa-Komaroff wanted to be a scientist from the time she was nine years old. "I always wanted to become a scientist, even as a very little girl, although I'm not sure that I really understood then what a scientist was," she noted. "I always wanted to find things out, and I knew that scientists did that."

Villa-Komaroff's career choice was influenced by her mother and grandmother, who had a deep love of plants and the natural world, as well as one of her uncles, who worked as a chemist. Her family—and especially her father—supported her interest in science and encouraged her to pursue it. "In the Mexican-American family, what papa says goes, so it's clear that his support made a difference in my life," she noted. Despite the support of her family, however, Villa-Komaroff still had to overcome some

sexist attitudes in the Mexican-American community. "Traditionally, Hispanic women are not socialized to believe they can earn a living, much less be scientists," she explained.

EDUCATION

Villa-Komaroff attended Lee Harvey Junior High School in Santa Fe, where the principal handed out letters for academic as well as athletic achievements, and Santa Fe High School. During the summer between her junior and senior years, she was selected to take part in a National Science Foundation Summer Science Training Program in Texas.

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After graduating from high school in 1965, Villa-Komaroff decided to go to college at the University of Washington in Seattle. "My parents fully accepted and supported my decision to go far away to college," she recalled. "In the southwestern Chicano culture that I came from, many parents, consciously or unconsciously, discourage children from pursuing higher education because they are afraid that . . . education will change their children or that the children will be lost to them. . . . I think it's incumbent on people like me to convince parents that they won't lose their child to education, but that it will enrich the child and thus the family."

At Washington, Villa-Komaroff intended to major in chemistry until a counselor told her that women did not belong in that field. After changing majors a few times, she eventually settled on biology. During one "incredibly exciting developmental biology course," she and other students slept in the lab so they could observe the development of frogs over a 48-hour period. Even though she loved science, college course work did not always come easily to her. "I flunked organic chemistry the first time I took it, but I got an 'A' the second time," she noted. "For myself, it was not the difficulty of the material. Discipline, hard work, and getting help when you need it makes the difference between good grades and bad grades."

Villa-Komaroff met her future husband, a medical student named Anthony Komaroff, during her freshman year at the University of Washington. The following year, Komaroff moved to Washington, D.C., to complete his medical internship. Villa-Komaroff then transferred to Goucher College in Maryland in order to be near him. This small women's college was the sister school of Johns Hopkins University. Johns Hopkins would have been her first choice, but it was not accepting female students at that time. She commented that Goucher "had very good chemistry and biology departments and had connections with the NIH [National Institutes of Health], enabling me to get summer jobs there." She earned a bachelor's degree in biology with honors in 1970, and she married Komaroff a short time after graduating.

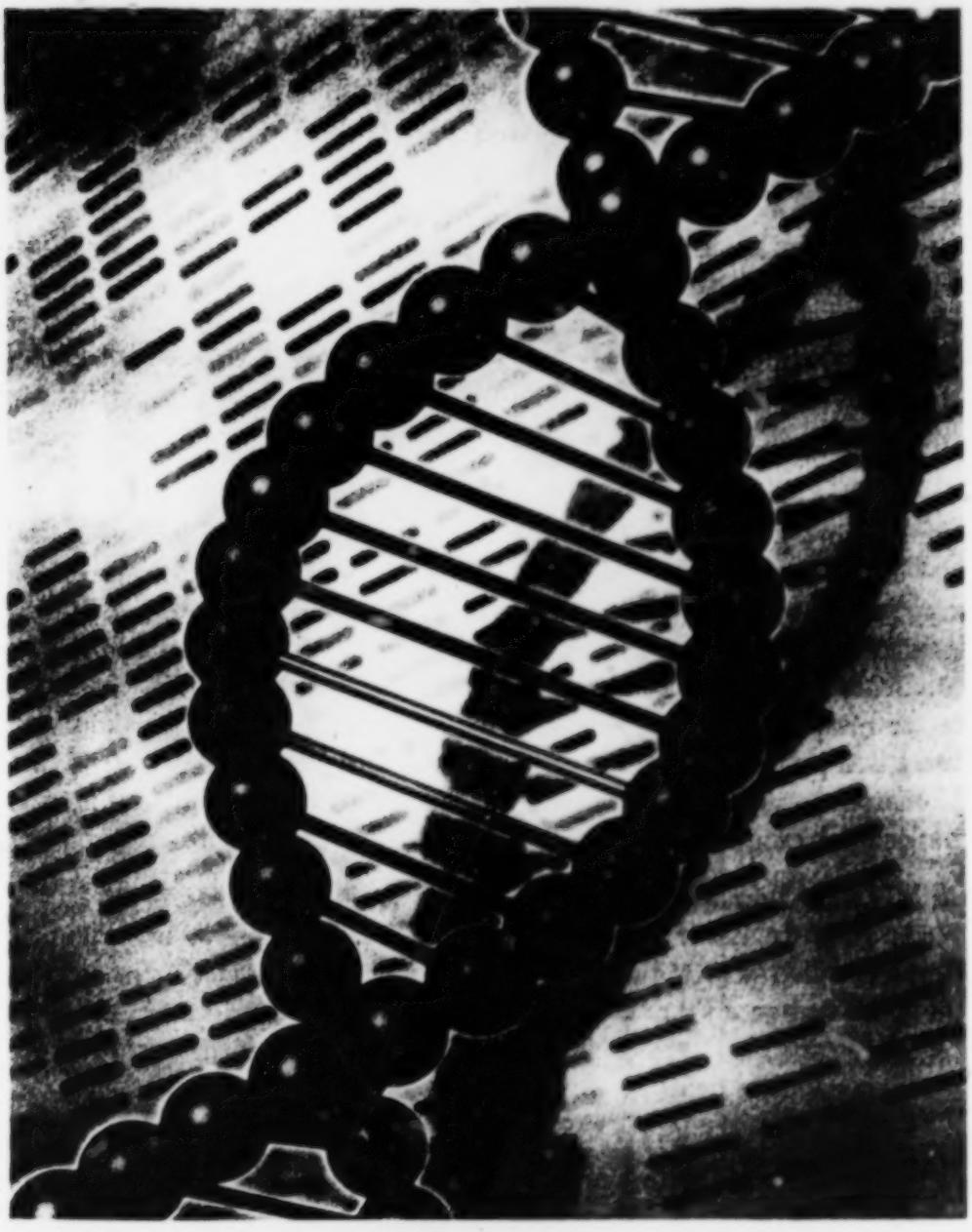
During her summer breaks at Goucher College, Villa-Komaroff worked at the NIH in a laboratory run by microbiologist Loretta Lieve. Lieve sparked her interest in molecular biology (the study of the role that certain molecules, like proteins and amino acids, play in forming cells and transmitting genetic information). Lieve encouraged Villa-Komaroff to pursue a graduate degree at the Massachusetts Institute of Technology (MIT). "I wanted to do research in developmental biology [at MIT], but the people who were doing it were not the people with whom I wanted to work," Villa-Komaroff recalled. "So I decided I should learn more about the field of molecular biology."

At MIT, Villa-Komaroff worked on a thesis about the polio virus under the guidance of the renowned scientists David Baltimore and Harvey Lodish. She has called her graduate school experience "the most fun part of my life." She earned a Ph.D. in cell biology in 1975, becoming only the third Mexican-American women in the United States to earn a doctorate degree in a scientific field.

CAREER HIGHLIGHTS

Becoming a Pioneer in Recombinant DNA

After earning her Ph.D., Villa-Komaroff received a post-doctoral fellowship to conduct research at Harvard University in Cambridge, Massachusetts. Her research focused on how cells develop into different specialized parts of an organism. "I am interested in the question of development: how you get from a single cell—the fertilized egg—to a person, where all of the tissues are in the right place and each organ knows what to do and when to do it," she explained. "That whole process is a remarkably complicated and beautifully orchestrated series of events."



An illustration of a DNA molecule, the double helix, over a diagram of a DNA fingerprint.

One of Villa-Komaroff's first research projects involved studying the structure of genes. Genes are made up of long combinations or strings of four chemicals—adenine, thymine, cytosine, and guanine (represented by the letters A, T, C, and G). A single gene may consist of between 50 million and 250 million of these chemical letters. The particular order of the chem-

icals in each gene provides a cell with instructions for producing or controlling different proteins that carry out the cell's work in the body. Genes determine a person's basic physical appearance and traits, such as their gender, height, and hair color. In addition, genes determine a person's likelihood of getting a number of different diseases.

Villa-Komaroff used a new technology known as recombinant DNA to study the structure of genes. DNA (deoxyribonucleic acid) is a long, twisted, ladder-like molecule that can be found inside the nucleus of cells. DNA consists of genes as well as other strings of chemicals that have no known purpose. The recombinant DNA technique involved combining the DNA from a complex organism, known as a eukaryote, with the DNA of a simple organism, known as a prokaryote. "Eukaryotes are creatures like mice, people, and silkworms that have cells where the genetic material, or DNA, is sequestered in the nucleus," Villa-Komaroff explained. "Bacteria are prokaryotes and have no nucleus." When Villa-Komaroff combined the DNA of a human or mouse with the DNA of bacteria, the combined DNA reproduced in the bacteria. This provided her with more DNA to look at, so that she could study the structure and activities of the genes in greater detail.

> ***"I am interested in the question of development: how you get from a single cell—the fertilized egg—to a person, where all of the tissues are in the right place and each organ knows what to do and when to do it. That whole process is a remarkably complicated and beautifully orchestrated series of events."***

Although the recombinant DNA technique held great possibilities for future research, some people worried that combining the DNA of different organisms might create something terrible. "The fear some people had was that if we took genes from one organism (a human) and put them into bacteria, we might somehow create a supergerm, a new disease," Villa-Komaroff noted. In 1975, the mayor of Cambridge banned Harvard researchers from working with recombinant DNA within the city limits. As a result, Villa-Komaroff and other scientists were forced to do their work elsewhere. She ended up working for a year in a laboratory in Cold Springs Harbor, New York. During this time, she attempted to isolate and clone (artificially produce or synthesize) the genes that form a silkworm's eggshell.

Complications of diabetes

Over time, untreated or poorly controlled diabetes can cause debilitating, even life-threatening, complications.

	What happens	Complications
Eyes	The small blood vessels of the retina become damaged.	Decreased vision and, ultimately, blindness.
Blood vessels	Plaque builds up and blocks arteries in major organs such as the heart and brain. The walls of blood vessels are damaged so that they can not transfer oxygen normally.	Poor circulation causes wounds to heal poorly and can lead to heart disease, stroke, gangrene of the feet and hands, impotence, and infections.
Kidneys	Blood vessels thicken; protein leaks into urine; blood isn't filtered normally.	Poor kidney function; kidney failure.
Nerves	Nerves are damaged because glucose isn't metabolized normally and because blood supply is inadequate.	Leg weakness; reduced sensation, tingling and pain in the hands and feet; chronic damage to nerves.

Source: MERCK Manual

Wm. J. Castello/**AP**

Producing Insulin from Bacteria

The controversy surrounding recombinant DNA soon faded, and Cambridge lifted its research ban in 1976. Upon returning to Harvard, Villa-Komaroff joined a laboratory run by the famous scientist Walter Gilbert. (For more information on Gilbert, see *Biography Today Scientists and Inventors*, Vol. 2.) She and other members of the research team successfully used the recombinant DNA technique to clone the gene that enables rats to produce insulin. (Insulin is a hormone, or string of proteins, produced in the pancreas that allows the body to turn sugar into energy. When the

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pancreas fails to produce enough insulin, a person suffers from diabetes. Diabetes is typically treated by giving the person additional insulin.)

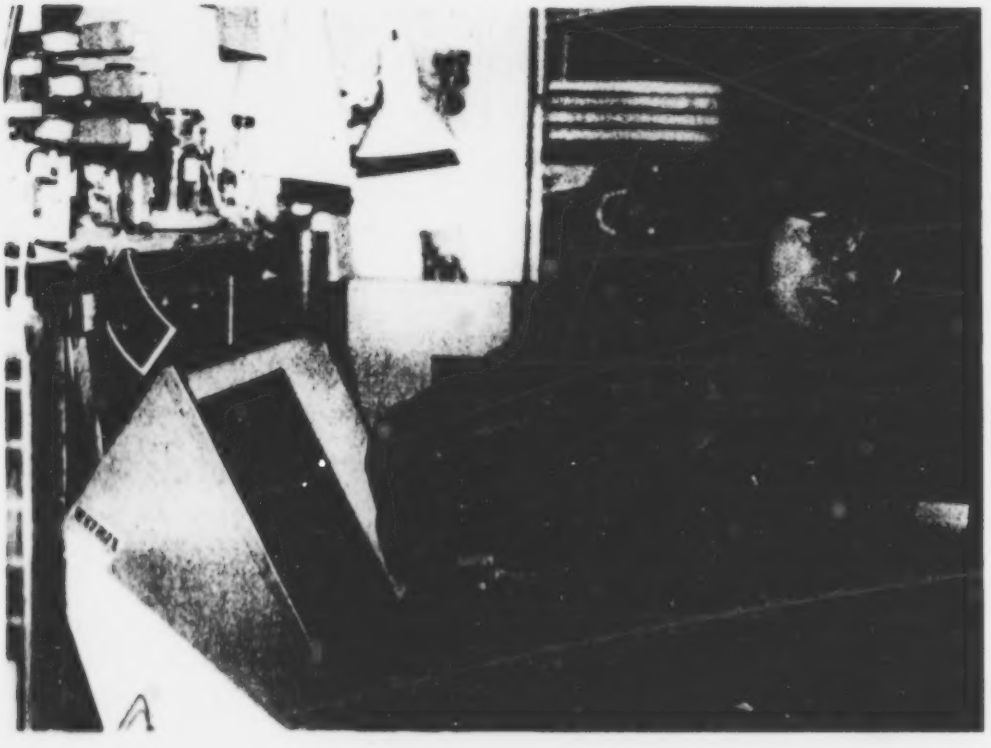
A short time later, Villa-Komaroff and the other scientists made a similar breakthrough with the human insulin gene. They combined the gene with bacteria and got it to reproduce. In this way, they demonstrated that bacteria could be used to grow insulin. This research marked the first time that a human hormone had been synthesized in bacteria. Today, most diabetics are treated with insulin that is produced in bacteria. "This was an incredibly exciting time to be working in recombinant DNA," Villa-Komaroff remembered. "Everyone was just realizing what a powerful tool it was."

"As I got older, I found that I wanted to think about science in a more global way. It gave me as much satisfaction to help another scientist find out how to get answers as it did to do my own experiments. Now my job is to help create an environment where other scientists can more easily do their work. I love my job and did not imagine when I was a student that I might one day have a job like this."

Combining Teaching and Research

When Villa-Komaroff's fellowship ended in 1978, she became an assistant professor at the University of Massachusetts Medical School. She taught courses in molecular genetics and microbiology to medical students. Unfortunately, her busy teaching schedule left little time for her to pursue her own research or write papers for scientific journals. For university professors, publishing academic papers is key to earning promotions, and also to earning tenure. Tenure is a special rank or status that protects teachers and professors from being fired. It provides tremendous job security, and it also gives professors the intellectual freedom to pursue their academic interests. Villa-Komaroff didn't have a lot of publications, and she struggled to gain tenure. After she finally received tenure in 1984, Villa-Komaroff decided to return to Harvard.

For the next ten years, Villa-Komaroff was a professor of neurology (the study of the nervous system and related disorders) at Harvard Medical School. She established her own laboratory at Harvard to conduct research on the role of insulin-related proteins in the development of the human



brain. Her work led to a greater understanding of a specific protein called insulin-like growth factor, or IGF-2. She and her research team showed that IGF-2 helps determine the number of cells in the brain. When the protein does not work properly and there are too many or too few cells, the person may develop mental retardation or epilepsy (a disorder of the nervous system that frequently produces seizures). During her years at Harvard, Villa-Komaroff published over 60 scientific papers about her research. In 1995, she was profiled in a six-part PBS documentary series on female scientists called *Discovering Women*.

Helping Fellow Scientists and Students

In 1994, Villa-Komaroff accepted a job as the vice president for research administration at Northwestern University in Evanston, Illinois. She also kept her title as professor of neurology at Northwestern. In her new job, Villa-Komaroff no longer ran her own laboratory and conducted her own research. Instead, she took charge of the overall scientific research efforts for the university. "As I got older, I found that I wanted to think about science in a more global way," she noted. "It gave me as much satisfaction to help another scientist find out how to get answers as it did to do my own experiments. Now my job is to help create an environment where other

scientists can more easily do their work. I love my job and did not imagine when I was a student that I might one day have a job like this."

Villa-Komaroff feels that her job as an educational administrator at Northwestern is consistent with her longtime view that encouraging students is as important as doing research. "There is not a child in the world, I don't think, who doesn't begin as a scientist," she stated. "I sometimes think that is our purpose in life. We were meant to be scientists and somehow we have managed to turn that off in most children. That is not necessary. We need to change that."

Villa-Komaroff is particularly interested in providing support for women and minorities who wish to pursue careers in the sciences. She is a founding member of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), and she remains active in the organization. She advises women and minorities to demand fair treatment. "I learned early on that it's a very good ploy to act confident even when you're not because then people perceive you as confident, and that makes a big difference," she stated. "You will not necessarily get what you deserve unless you're quite aggressive about demanding it, and that can be done with grace and skill."

"I learned early on that it's a very good ploy to act confident even when you're not because then people perceive you as confident, and that makes a big difference. You will not necessarily get what you deserve unless you're quite aggressive about demanding it, and that can be done with grace and skill."

Villa-Komaroff has always provided research opportunities for college undergraduate and even high school students in her laboratories. She also makes presentations at high schools in which she encourages students to take math courses in order to keep their career options open. "I've been lucky to have had options in my life," she noted. "That, combined with hard work, has paid off enormously for me and resulted in an exciting and completely satisfying life."

MARRIAGE AND FAMILY

Villa-Komaroff met her future husband, Anthony L. Komaroff, when he accidentally tripped her in the cafeteria at the University of Washington.

They were married in 1970, after she graduated from Goucher College. When Villa-Komaroff accepted her job as vice president for research administration at Northwestern University in Chicago, her husband remained in Boston. They now maintain two households and enjoy a "commuter marriage." "We were determined to make it work, and it has," she noted. "We get together once every two weeks in either Boston or Chicago. For two workaholics, it may be ideal." Villa-Komaroff, who does not have children of her own, is very close to her many nieces and nephews.

HOBBIES AND OTHER INTERESTS

In her spare time, Villa-Komaroff enjoys photography and reading, especially mystery books. "Through reading, you learn things you didn't know," she stated. "Even today, I have books everywhere in my house—in the bedroom, even in the bathroom!"

HONORS AND AWARDS

Helen Hay Whitney Foundation Fellowship: 1975
Hispanic Engineer National Achievement Award in College Education: 1992
Hispanic Achievement Award in Science: 1996
100 Most Influential Hispanics: 1997

FURTHER READING

Books

Ambrose, Susan A. *Journeys of Women in Science and Engineering: No Universal Constants*, 1997
American Men and Women of Science, 17th ed., 1989
Bailey, Martha J. *American Women in Science: 1950 to the Present*, 1998
Hall, Stephen S. *Invisible Frontiers: The Race to Synthesize a Human Gene*, 1987
Notable Hispanic American Women, 1998
Notable Women Scientists, 2000
St. John, Betty. *Hispanic Scientists*, 1996
Who's Who in America, 2002
Who's Who of American Women, 2000-2001

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Science, Mar. 29, 1996, p.1902

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WORLD WIDE WEB SITES

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http://pr.gallaudet.edu/otg/1998/980930/villakomaroff.html
http://www.witi.com/center/witimuseum/womeninsciencet/1996

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How to Use the Cumulative Index

Our indexes have a new look. In an effort to make our indexes easier to use, we've combined the Name and General Index into a new, cumulative General Index. This single ready-reference resource covers all the volumes in *Biography Today,* both the general series and the special subject series. The new General Index contains complete listings of all individuals who have appeared in *Biography Today* since the series began. Their names appear in bold-faced type, followed by the issue in which they appear. The General Index also includes references for the occupations, nationalities, and ethnic and minority origins of individuals profiled in *Biography Today.*

We have also made some changes to our specialty indexes, the Places of Birth Index and the Birthday Index. To consolidate and to save space, the Places of Birth Index and the Birthday Index will no longer appear in the January and April issues of the softbound subscription series. But these indexes can still be found in the September issue of the softbound subscription series, in the hardbound Annual Cumulation at the end of each year, and in each volume of the special subject series.

General Series

The General Series of *Biography Today* is denoted in the index with the month and year of the issue in which the individual appeared. Each individual also appears in the Annual Cumulation for that year.

Bush, George W. . . . . . Sep 00; Update 00; Update 01
Cheney, Dick . . . . . Jan 02
Earnhardt, Dale . . . . . Apr 01
Hill, Faith . . . . . Sep 01
Holdsclaw, Chamique . . . . . Sep 00
Kim Dae-jung . . . . . Sep 01
L'Engle, Madeleine . . . . . Jan 92; Apr 01
***N Sync** . . . . . Jan 01
Radcliffe, Daniel . . . . . Jan 02
Roberts, Julia . . . . . Sep 01
Rowling, J.K. . . . . . Sep 99; Update 00; Update 01
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Tucker, Chris . . . . . Jan 01

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Special Subject Series

The Special Subject Series of *Biography Today* are each denoted in the index with an abbreviated form of the series name, plus the number of the volume in which the individual appears. They are listed as follows.

Adams, Ansel ..... Artist V.1 (Artists Series)
Bauer, Joan ..... Author V.10 (Author Series)
Collins, Francis ..... Science V.6 (Scientists & Inventors Series)
George, Eddie ..... Sport V.6 (Sports Series)
Peterson, Roger Tory ..... WorLdr V.1 (World Leaders Series: Environmental Leaders)
Sadat, Anwar ..... WorLdr V.2 (World Leaders Series: Modern African Leaders)
Wolf, Hazel ..... WorLdr V.3 (World Leaders Series: Environmental Leaders 2)

Updates

Updated information on selected individuals appears in the Appendix at the end of the *Biography Today* Annual Cumulation. In the index, the original entry is listed first, followed by any updates.

Arafat, Yasir ..... Sep 94; Update 94; Update 95; Update 96; Update 97; Update 98; Update 00; Update 01
Gates, Bill ..... Apr 93; Update 98; Update 00; Science V.5; Update 01
Griffith Joyner, Florence ..... Sport V.1; Update 98
Sanders, Barry ..... Sep 95; Update 99
Spock, Dr. Benjamin ..... Sep 95; Update 98
Yeltsin, Boris ..... Apr 92; Update 93; Update 95; Update 96; Update 98; Update 00

General Index

This index includes names, occupations, nationalities, and ethnic and minority origins that pertain to individuals profiled in *Biography Today*.

Aaliyah ..... Jan 02
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Abbey, Edward ..... WorLdr V.1
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Aung San Suu Kyi ..... Apr 96; Update 98; Update 01
Banda, Hastings Kamuzu ..... WorLdr V.2
Bates, Daisy ..... Apr 00
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Calderone, Mary S. ..... Science V.3
Chavez, Cesar ..... Sep 93
Chavis, Benjamin ..... Jan 94; Update 94
Cronin, John ..... WorLdr V.3
Dai Qing ..... WorLdr V.3
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Douglas, Marjory Stoneman ..... WorLdr V.1; Update 98
Edelman, Marian Wright ..... Apr 93
Foreman, Dave ..... WorLdr V.1
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Jackson, Jesse ..... Sep 95; Update 01
Ka Hsaw Wa ..... WorLdr V.3
Kaunda, Kenneth ..... WorLdr V.2
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LaDuke, Winona ..... WorLdr V.3; Update 00
Love, Susan ..... Science V.3
Maathai, Wangari ..... WorLdr V.1
Mandela, Nelson ..... Jan 92; Update 94; Update 01
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Erdos, Paul – *Budapest* ..... Science V.2
Idaho
Street, Picabo – *Triumph* ..... Sport V.3
Illinois
Anderson, Gillian – *Chicago* ..... Jan 97
Bauer, Joan – *River Forest* ..... Author V.10
Blackmun, Harry – *Nashville* ..... Jan 00
Boyd, Candy Dawson – *Chicago* ..... Author V.3
Bradbury, Ray – *Waukegan* ..... Author V.3
Clinton, Hillary Rodham – *Chicago* ..... Apr 93
Crawford, Cindy – *De Kalb* ..... Apr 93
Crichton, Michael – *Chicago* ..... Author V.5
Cushman, Karen – *Chicago* ..... Author V.5
Garth, Jennie – *Urbana* ..... Apr 96
Ford, Harrison – *Chicago* ..... Sep 97
Hansberry, Lorraine – *Chicago* ..... Author V.5
Joyner-Kersee, Jackie – *East St. Louis* ..... Oct 92
Margulis, Lynn – *Chicago* ..... Sep 96
McCully, Emily Arnold – *Galesburg* ..... Jul 92
McGruder, Aaron – *Chicago* ..... Author V.10
Peck, Richard – *Decatur* ..... Author V.10
Silverstein, Shel – *Chicago* ..... Author V.3
Siskel, Gene – *Chicago* ..... Sep 99
Watson, James D. – *Chicago* ..... Science V.1
Williams, Michelle – *Rockford* ..... Apr 01
Wrede, Patricia C. – *Chicago* ..... Author V.7
Indiana
Bird, Larry – *West Baden* ..... Jan 92
Davis, Jim – *Marion* ..... Author V.1
Letterman, David – *Indianapolis* ..... Jan 95
Naylor, Phyllis Reynolds – *Anderson* ..... Apr 93
Pauley, Jane – *Indianapolis* ..... Oct 92
Peet, Bill – *Grandview* ..... Author V.4
Vonnegut, Kurt – *Indianapolis* ..... Author V.1
Iowa
Leopold, Aldo – *Burlington* ..... WorLdr V.3
Warner, Kurt – *Burlington* ..... Sport V.4
Iraq
Hussein, Saddam – *al-Auja* ..... Jul 92
Ireland, Northern
Lewis, C. S. – *Belfast* ..... Author V.3
Ireland, Republic of
Flannery, Sarah – *Blarney, County Cork* ..... Science V.5
Robinson, Mary – *Ballina* ..... Sep 93
Israel
Perlman, Itzhak – *Tel Aviv* ..... Jan 95
Portman, Natalie – *Jerusalem* ..... Sep 99
Rabin, Yitzhak – *Jerusalem* ..... Oct 92
Italy
Andretti, Mario – *Montona* ..... Sep 94
Krim, Mathilde – *Como* ..... Science V.1
Levi-Montalcini, Rita – *Turin* ..... Science V.1
Jamaica
Ashley, Maurice – *St. Andrew* ..... Sep 99
Bailey, Donovan – *Manchester* ..... Sport V.2
Denton, Sandi – *Kingston* ..... Apr 95
Ewing, Patrick – *Kingston* ..... Jan 95
Maxwell, Jody-Anne – *St. Andrew* ..... Sep 98
Japan
Miyamoto, Shigeru – *Sonobe* ..... Science V.5
Morita, Akio – *Kasugaya* ..... Science V.4
Suzuki, Shinichi – *Nagoya* ..... Sep 98
Uchida, Mitsuko – *Tokyo* ..... Apr 99
Jordan
Hussein, King – *Amman* ..... Apr 99
Kansas
Alley, Kirstie – *Wichita* ..... Jul 92
Ballard, Robert – *Wichita* ..... Science V.4
Brooks, Gwendolyn – *Topeka* ..... Author V.3
Dole, Bob – *Russell* ..... Jan 96
Parks, Gordon – *Fort Scott* ..... Artist V.1
Patrick, Ruth ..... Science V.3
Probst, Jeff – *Wichita* ..... Jan 01
Sanders, Barry – *Wichita* ..... Sep 95
Stiles, Jackie – *Kansas City* ..... Sport V.6
Kentucky
Ali, Muhammad – *Louisville* ..... Sport V.2
Littrell, Brian – *Lexington* ..... Jan 00
Monroe, Bill – *Rosine* ..... Sep 97
Morgan, Garrett – *Paris* ..... Science V.2
Richardson, Kevin – *Lexington* ..... Jan 00
Kenya
Leakey, Louis – *Nairobi* ..... Science V.1
Kenyatta, Jomo – *Ngenda* ..... WorLdr V.2
Maathai, Wangari – *Nyeri* ..... WorLdr V.1
Ndeti, Cosmas – *Machakos* ..... Sep 95
Liberia
Tubman, William V. S. – *Harper City* ..... WorLdr V.2
Libya
Qaddafi, Muammar ..... Apr 97
Louisiana
Dumars, Joe – *Natchitoches* ..... Sport V.3
Gumbel, Bryant – *New Orleans* ..... Apr 97

Manning, Peyton – *New Orleans* . . . . Sep 00
Marsalis, Wynton – *New Orleans* . . . Apr 92
Rice, Anne – *New Orleans*. . . . . Author V.3
Roberts, Cokie – *New Orleans* . . . . . Apr 95
Spears, Britney – *Kentwood* . . . . . Jan 01
Stewart, Kordell – *Marrero*. . . . . Sep 98

Macedonia

Teresa, Mother – *Skopje*. . . . . Apr 98

Maine

King, Stephen – *Portland* . . . . . Author V.1

Malawi

Banda, Hastings Kamuzu
– *Chiwengo, Nyasaland* . . . . . WorLdr V.2

Maryland

Atwater-Rhodes, Amelia
– *Silver Spring* . . . . . Author V.8
Hesse, Karen – *Baltimore* . . . . . Author V.5
Marshall, Thurgood – *Baltimore*. . . . . Jan 92
Ripken, Cal, Jr. – *Havre de Grace*. . Sport V.1

Massachusetts

Bush, George – *Milton*. . . . . Jan 92
Butcher, Susan – *Cambridge* . . . . . Sport V.1
Caplan, Arthur – *Boston* . . . . . Science V.6
Cormier, Robert – *Leominister* . . Author V.1
Fanning, Shawn – *Brockton* . . . . Science V.5
Gilbert, Walter – *Cambridge*. . . . Science V.2
Grandin, Temple – *Boston*. . . . . Science V.3
Guey, Wendy – *Boston* . . . . . Sep 96
Guy, Jasmine – *Boston* . . . . . Sep 93
Kerrigan, Nancy – *Woburn* . . . . . Apr 94
Krakauer, Jon – *Brookline* . . . . . Author V.6
Pine, Elizabeth Michele – *Boston* . . . . Jan 94
Scarry, Richard – *Boston* . . . . . Sep 94
Seuss, Dr. – *Springfield* . . . . . Jan 92
Speare, Elizabeth George – *Melrose* . Sep 95
Thompson, Jenny – *Georgetown* . . Sport V.5
Voigt, Cynthia – *Boston*. . . . . Oct 92
Walters, Barbara – *Boston*. . . . . Sep 94

Mexico

Rivera, Diego – *Guanajuato* . . . . . Artist V.1

Michigan

Applegate, K.A. . . . . Jan 00
Askins, Renee. . . . . WorLdr V.1
Canady, Alexa – *Lansing* . . . . . Science V.6
Carson, Ben – *Detroit*. . . . . Science V.4
Curtis, Christopher Paul – *Flint* Author V.4
Galeczka, Chris – *Sterling Heights* . . . Apr 96
Johnson, Magic – *Lansing* . . . . . Apr 92
Kiraly, Karch – *Jackson* . . . . . Sport V.4
Krone, Julie – *Benton Harbor*. . . . . Jan 95
Lalas, Alexi – *Royal Oak* . . . . . Sep 94
Mohajer, Dineh – *Bloomfield Hills* . . . Jan 02
Riley, Dawn – *Detroit*. . . . . Sport V.4
Scieszka, Jon – *Flint* . . . . . Author V.9
Shabazz, Betty – *Detroit* . . . . . Apr 98
Small, David – *Detroit* . . . . . Author V.10
Van Allsburg, Chris – *Grand Rapids*. . Apr 92
Ward, Lloyd D. – *Romulus* . . . . . Jan 01
Webb, Alan – *Ann Arbor* . . . . . Sep 01
Williams, Serena – *Saginaw* . . . . . Sport V.4
Winans, CeCe – *Detroit* . . . . . Apr 00

Minnesota

Burger, Warren – *St. Paul*. . . . . Sep 95
Douglas, Marjory Stoneman
– *Minneapolis*. . . . . WorLdr V.1
Madden, John – *Austin*. . . . . Sep 97
Mars, Forrest, Sr. – *Minneapolis* Science V.4
Murie, Olaus J. . . . . WorLdr V.1
Paulsen, Gary – *Minneapolis* . . . Author V.1
Ryder, Winona – *Winona* . . . . . Jan 93
Schulz, Charles – *Minneapolis* . . Author V.2
Scurry, Briana – *Minneapolis*. . . . . Jan 00
Ventura, Jesse – *Minneapolis*. . . . . Apr 99
Weinke, Chris – *St. Paul*. . . . . Apr 01
Winfield, Dave – *St. Paul*. . . . . Jan 93

Mississippi

Bass, Lance – *Clinton* . . . . . Jan 01
Brandy – *McComb*. . . . . Apr 96
Favre, Brett – *Gulfport* . . . . . Sport V.2
Hill, Faith – *Jackson* . . . . . Sep 01
Jones, James Earl – *Arkabutla*
Township . . . . . Jan 95
McCarty, Oseola – *Wayne County* . . . Jan 99
Payton, Walter – *Columbia* . . . . . Jan 00
Rice, Jerry – *Crawford* . . . . . Apr 93
Rimes, LeAnn – *Jackson*. . . . . Jan 98
Taylor, Mildred D. – *Jackson* . . . . Author V.1
Winfrey, Oprah – *Kosciusko*. . . . . Apr 92
Wright, Richard – *Natchez* . . . . . Author V.5

Missouri

Angelou, Maya – *St. Louis* . . . . . Apr 93
Champagne, Larry III – *St. Louis* . . . . Apr 96
Goodman, John – *Affton* . . . . . Sep 95
Heinlein, Robert – *Butler* . . . . . Author V.4
Hughes, Langston – *Joplin* . . . . . Author V.7
Lester, Julius – *St. Louis* . . . . . Author V.7
Limbaugh, Rush – *Cape Girardeau* . . Sep 95
Miller, Shannon – *Rolla* . . . . . Sep 94
Nye, Naomi Shihab – *St. Louis* . . Author V.8

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Montana
Carvey, Dana – *Missoula* . . . . . Jan 93
Horner, Jack – *Shelby* . . . . . Science V.1
Lowe, Alex – *Missoula* . . . . . Sport V.4
Morocco
Hassan II – *Rabat* . . . . . WorLdr V.2
Myanmar
see Burma
Nebraska
Cheney, Dick – *Lincoln* . . . . . Jan 02
Nevada
Agassi, Andre – *Las Vegas* . . . . . Jul 92
New Hampshire
Zirkle, Aliy – *Manchester* . . . . . Sport V.6
New Jersey
Blume, Judy . . . . . Jan 92
Carpenter, Mary Chapin
– *Princeton* . . . . . Sep 94
Earle, Sylvia – *Gibbstown* . . . . . Science V.1
Clover, Savion – *Newark* . . . . . Apr 99
Gwaltney, John Langston –
Orange . . . . . Science V.3
Hill, Lauryn – *South Orange* . . . . . Sep 99
Houston, Whitney – *Newark* . . . . . Sep 94
Ice-T – *Newark* . . . . . Apr 93
Jeter, Derek – *Pequannock* . . . . . Sport V.4
Lawrence, Jacob – *Atlantic City* . . Artist V.1
Love, Susan – *Long Branch* . . . . Science V.3
Martin, Ann M. – *Princeton* . . . . . Jan 92
Muniz, Frankie – *Ridgewood* . . . . . Jan 01
O'Neal, Shaquille – *Newark* . . . . . Sep 93
Pinsky, Robert – *Long Branch* . . Author V.7
Queen Latifah – *Newark* . . . . . Apr 92
Rodman, Dennis – *Trenton* . . . . . Apr 96
Schwarzkopf, H. Norman – *Trenton* . . Jan 92
Sinatra, Frank – *Hoboken* . . . . . Jan 99
Thomas, Dave – *Atlantic City* . . . . . Apr 96
New Mexico
Bezos, Jeff – *Albuquerque* . . . . . Apr 01
Foreman, Dave – *Albuquerque* . . . WorLdr V.1
Villa-Komaroff, Lydia –
Las Vegas . . . . . Science V.6
New York State
Aaliyah – *Brooklyn* . . . . . Jan 02
Abdul-Ja r, Kareem
– *New York City* . . . . . Sport V.1
Abzug, Bella – *Bronx* . . . . . Sep 98
Aguilera, Christina – *Staten Island* . . Apr 00
Avi – *New York City* . . . . . Jan 93
Baldwin, James
– *New York City* . . . . . Author V.2
Bennett, Cherie – *Buffalo* . . . . . Author V.9
Blair, Bonnie – *Cornwall* . . . . . Apr 94
Bourke-White, Margaret
– *New York City* . . . . . Artist V.1
Brody, Jane – *Brooklyn* . . . . . Science V.2
Burke, Chris – *New York City* . . . . . Sep 93
Burns, Ken – *Brooklyn* . . . . . Jan 95
Bush, Barbara – *New York City* . . . . . Jan 92
Calderone, Mary S.
– *New York City* . . . . . Science V.3
Capriati, Jennifer – *Long Island* . . . Sport V.6
Carey, Mariah – *New York City* . . . . . Apr 96
Carle, Eric – *Syracuse* . . . . . Author V.1
Carter, Nick – *Jamestown* . . . . . Jan 00
Cohen, Adam Ezra – *New York City* Apr 97
Collins, Eileen – *Elmira* . . . . . Science V.4
Combs, Sean (Puff Daddy)
– *New York City* . . . . . Apr 98
Cooney, Barbara – *Brooklyn* . . . . Author V.8
Cooney, Caroline B. – *Geneva* . . . Author V.4
Coville, Bruce – *Syracuse* . . . . . Author V.9
Cronin, John – *Yonkers* . . . . . WorLdr V.3
Culkin, Macaulay – *New York City* . . Sep 93
Danes, Claire – *New York City* . . . . . Sep 97
de Mille, Agnes – *New York City* . . . . Jan 95
Duchovny, David – *New York City* . . Apr 96
Elion, Gertrude
– *New York City* . . . . . Science V.6
Farrakhan, Louis – *Bronx* . . . . . Jan 97
Fatone, Joey – *Brooklyn* . . . . . Jan 01
Frankenthaler, Helen
– *New York City* . . . . . Artist V.1
Gellar, Sarah Michelle
– *New York City* . . . . . Jan 99
Giff, Patricia Reilly – *Queens* . . . . Author V.7
Ginsburg, Ruth Bader – *Brooklyn* . . . . Jan 94
Goldberg, Whoopi
– *New York City* . . . . . Apr 94
Gould, Stephen Jay
– *New York City* . . . . . Science V.2
Haley, Alex – *Ithaca* . . . . . Apr 92
Hart, Melissa Joan – *Smithtown* . . . . . Jan 94
Healy, Bernadine – *Queens* . . . . Science V.1
Holdsclaw, Chamique – *Queens* . . . . . Sep 00
Hopper, Grace Murray
– *New York City* . . . . . Science V.5
James, Cheryl – *New York City* . . . . . Apr 95
Jordan, Michael – *Brooklyn* . . . . . Jan 92
Kamler, Kenneth
– *New York City* . . . . . Science V.6
Kerr, M.E. – *Auburn* . . . . . Author V.1

Konigsburg, E.L.
– *New York City* ..... Author V.3
Kurzweil, Raymond
– *New York City* ..... Science V.2
Lee, Stan – *New York City* ..... Author V.7
Lemelson, Jerome – *Staten Island* ..... Science V.3
L'Engle, Madeleine – *New York City* ..... Jan 92; Apr 01
Leno, Jay – *New Rochelle* ..... Jul 92
Lewis, Shari – *New York City* ..... Jan 99
Lisanti, Mariangela – *Bronx* ..... Sep 01
Lopez, Jennifer – *Bronx* ..... Jan 02
Lowman, Meg – *Elmira* ..... Science V.4
Mittermeier, Russell A.
– *New York City* ..... WorLdr V.1
Moses, Grandma – *Greenwich* ... Artist V.1
Moss, Cynthia – *Ossining* ..... WorLdr V.3
O'Donnell, Rosie – *Commack* ..... Apr 97
Oppenheimer, J. Robert
– *New York City* ..... Science V.1
Pascal, Francine
– *New York City* ..... Author V.6
Peterson, Roger Tory
– *Jamestown* ..... WorLdr V.1
Pike, Christopher – *Brooklyn* ..... Sep 96
Powell, Colin – *New York City* ..... Jan 92
Prelutsky, Jack – *Brooklyn* ..... Author V.2
Reeve, Christopher – *Manhattan* .... Jan 97
Rinaldi, Ann – *New York City* ... Author V.8
Ringgold, Faith – *New York City* . Author V.2
Rockwell, Norman
– *New York City* ..... Artist V.1
Rodriguez, Alex – *New York City* .. Sport V.6
Roper, Dee Dee – *New York City* .... Apr 95
Sachar, Louis – *East Meadow* ... Author V.6
Sagan, Carl – *Brooklyn* ..... Science V.1
Salinger, J.D. – *New York City* .. Author V.2
Salk, Jonas – *New York City* ..... Jan 94
Sealfon, Rebecca – *New York City* ... Sep 97
Seinfeld, Jerry – *Brooklyn* ..... Oct 92
Sendak, Maurice – *Brooklyn* .... Author V.2
Shakur, Tupac – *Bronx* ..... Apr 97
Strasser, Todd – *New York City* .. Author V.7
Washington, Denzel – *Mount Vernon* .. Jan 93
Wayans, Keenen Ivory
– *New York City* ..... Jan 93
White, E.B. – *Mount Vernon* .... Author V.1
Williams, Garth – *New York City* . Author V.2
Yolen, Jane – *New York City* .... Author V.7
Zindel, Paul – *Staten Island* .... Author V.1

New Zealand

Hillary, Sir Edmund – *Auckland* .... Sep 96

Nigeria

Olajuwon, Hakeem – *Lagos* ..... Sep 95
Saro-Wiwa, Ken – *Bori, Rivers State* ..... WorLdr V.1

North Carolina

Bearden, Romare – *Charlotte* ..... Artist V.1
Byars, Betsy – *Charlotte* ..... Author V.4
Chavis, Benjamin – *Oxford* ..... Jan 94
Delany, Bessie – *Raleigh* ..... Sep 99
Dole, Elizabeth Hanford – *Salisbury* .. Jul 92
Earnhardt, Dale – *Kannapolis* ..... Apr 01
Petty, Richard – *Level Cross* ..... Sport V.2
Williamson, Kevin – *New Bern* .. Author V.6

Norway

Brundtland, Gro Harlem
– *Baerum* ..... Science V.3

Ohio

Anderson, Terry – *Lorain* ..... Apr 92
Battle, Kathleen – *Portsmouth* ..... Jan 93
Berry, Halle – *Cleveland* ..... Jan 95
Creech, Sharon – *Mayfield Heights* ..... Author V.5
Dove, Rita – *Akron* ..... Jan 94
Draper, Sharon – *Cleveland* ..... Apr 99
Dunbar, Paul Laurence
– *Dayton* ..... Author V.8
Glenn, John – *Cambridge* ..... Jan 99
Guisewite, Cathy – *Dayton* ..... Sep 93
Hamilton, Virginia – *Yellow Springs* ..... Author V.1
Hampton, David ..... Apr 99
Harbaugh, Jim – *Toledo* ..... Sport V.3
Holmes, Katie – *Toledo* ..... Jan 00
Lin, Maya – *Athens* ..... Sep 97
Lovell, Jim – *Cleveland* ..... Jan 96
Morrison, Toni – *Lorain* ..... Jan 94
Nicklaus, Jack – *Columbus* ..... Sport V.2
Perry, Luke – *Mansfield* ..... Jan 92
Rose, Pete – *Cincinnati* ..... Jan 92
Shula, Don – *Grand River* ..... Apr 96
Spielberg, Steven – *Cincinnati* ..... Jan 94
Steinem, Gloria – *Toledo* ..... Oct 92
Stine, R.L. – *Columbus* ..... Apr 94
Tompkins, Douglas
– *Conneaut* ..... WorLdr V.3
Woodson, Jacqueline
– *Columbus* ..... Author V.7

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Oklahoma
Brooks, Garth – *Tulsa* . . . . . Oct 92
Duke, David – *Tulsa* . . . . . Apr 92
Ellison, Ralph – *Oklahoma City* . . Author V.3
Hanson, Ike – *Tulsa* . . . . . Jan 98
Hanson, Taylor – *Tulsa* . . . . . Jan 98
Hanson, Zac – *Tulsa* . . . . . Jan 98
Hill, Anita – *Morris* . . . . . Jan 93
Hinton, S.E. – *Tulsa* . . . . . Author V.1
Mankiller, Wilma – *Tahlequah* . . . . . Apr 94
Mantle, Mickey – *Spavinaw* . . . . . Jan 96
McEntire, Reba – *McAlester* . . . . . Sep 95
Pitt, Brad – *Shawnee* . . . . . Sep 98
Oregon
Cleary, Beverly – *McMinnville* . . . . . Apr 94
Engelbart, Douglas – *Portland* . . Science V.5
Groening, Matt – *Portland* . . . . . Jan 92
Harding, Tonya – *Portland* . . . . . Sep 94
Hooper, Geoff – *Salem* . . . . . Jan 94
Pauling, Linus – *Portland* . . . . . Jan 95
Phoenix, River – *Madras* . . . . . Apr 94
Schroeder, Pat – *Portland* . . . . . Jan 97
Pakistan
Bhutto, Benazir – *Karachi* . . . . . Apr 95
Masih, Iqbal . . . . . Jan 96
Palestine
Perlman, Itzhak – *Tel Aviv* . . . . . Jan 95
Rabin, Yitzhak – *Jerusalem* . . . . . Oct 92
Panama
McCain, John – *Panama Canal Zone* . . . . . Apr 00
Pennsylvania
Abbey, Edward – *Indiana* . . . . . WorLdr V.1
Alexander, Lloyd – *Philadelphia* . Author V.6
Anderson, Marian – *Philadelphia* . . . . Jan 94
Armstrong, Robb – *Philadelphia* . . Author V.9
Berenstain, Jan – *Philadelphia* . . Author V.2
Berenstain, Stan – *Philadelphia* . Author V.2
Bradley, Ed – *Philadelphia* . . . . . Apr 94
Bryant, Kobe – *Philadelphia* . . . . . Apr 99
Calder, Alexander – *Lawnton* . . . . Artist V.1
Carson, Rachel – *Springdale* . . . WorLdr V.1
Chamberlain, Wilt – *Philadelphia* . . Sport V.4
Cosby, Bill . . . . . Jan 92
DiCamillo, Kate – *Philadelphia* . . Author V.10
Diemer, Walter – *Philadelphia* . . . . . Apr 98
Duncan, Lois – *Philadelphia* . . . . . Sep 93
Gantos, Jack – *Mount Pleasant* . . Author V.10
George, Eddie – *Philadelphia* . . . . . Sport V.6
Gingrich, Newt – *Harrisburg* . . . . . Apr 95
Griffey, Ken, Jr. – *Donora* . . . . . Sport V.1
Iacocca, Lee A. – *Allentown* . . . . . Jan 92
Jamison, Judith – *Philadelphia* . . . . . Jan 96
Kirkpatrick, Chris – *Clarion* . . . . . Jan 01
Lipinski, Tara – *Philadelphia* . . . . . Apr 98
Marino, Dan – *Pittsburgh* . . . . . Apr 93
McCary, Michael – *Philadelphia* . . . . . Jan 96
Mead, Margaret – *Philadelphia* . Science V.2
Montana, Joe – *New Eagle* . . . . . Jan 95
Morris, Nathan – *Philadelphia* . . . . . Jan 96
Morris, Wanya – *Philadelphia* . . . . . Jan 96
Pinkney, Jerry – *Philadelphia* . . . Author V.2
Smith, Will – *Philadelphia* . . . . . Sep 94
Smyers, Karen – *Corry* . . . . . Sport V.4
Stanford, John – *Darby* . . . . . Sep 99
Stockman, Shawn – *Philadelphia* . . . . Jan 96
Thomas, Jonathan Taylor – *Bethlehem* . . . . . Apr 95
Van Meter, Vicki – *Meadville* . . . . . Jan 95
Warhol, Andy . . . . . Artist V.1
Wilson, August – *Pittsburgh* . . . . Author V.4
Poland
John Paul II – *Wadowice* . . . . . Oct 92
Opdyke, Irene Gut – *Kozienice* . . Author V.9
Sabin, Albert – *Bialystok* . . . . . Science V.1
Puerto Rico
Lopez, Charlotte . . . . . Apr 94
Martin, Ricky – *Santurce* . . . . . Jan 00
Novello, Antonia – *Fajardo* . . . . . Apr 92
Romania
Dumitriu, Ioana – *Bucharest* . . . Science V.3
Nechita, Alexandra – *Vaslui* . . . . . Jan 98
Risca, Viviana – *Bucharest* . . . . . Sep 00
Russia
Asimov, Isaac – *Petrovichi* . . . . . Jul 92
Chagall, Marc – *Vitebsk* . . . . . Artist V.1
Fedorov, Sergei – *Pskov* . . . . . Apr 94
Gorbachev, Mikhail – *Privolnoye* . . . . Jan 92
Nevelson, Louise – *Kiev* . . . . . Artist V.1
Nureyev, Rudolf . . . . . Apr 93
Yeltsin, Boris – *Butka* . . . . . Apr 92
Scotland
Muir, John – *Dunbar* . . . . . WorLdr V.3
Senegal
Senghor, Léopold Sédar – *Joal* . . . . . WorLdr V.2
Serbia
Milosevic, Slobodan – *Pozarevac* . . . . Sep 99
Seles, Monica – *Novi Sad* . . . . . Jan 96
Somalia
Aidid, Mohammed Farah . . . . . WorLdr V.2

South Africa
de Klerk, F.W. – *Mayfair* ..... Apr 94
Mandela, Nelson – *Umtata, Transkei* .. Jan 92
Mandela, Winnie
– *Pondoland, Transkei* ..... WorLdr V.2
Tolkien, J.R.R. – *Bloemfontein* ..... Jan 02
South Carolina
Childress, Alice – *Charleston* ... Author V.1
Daniel, Beth – *Charleston* ..... Sport V.1
Edelman, Marian Wright
– *Bennettsville* ..... Apr 93
Garnett, Kevin – *Greenville* ..... Sport V.6
Gillespie, Dizzy – *Cheraw* ..... Apr 93
Hunter-Gault, Charlayne
– *Due West* ..... Jan 00
Jackson, Jesse – *Greenville* ..... Sep 95
South Korea
Kim Dae-jung – *Hugwang* ..... Sep 01
Pak, Se Ri – *Daejeon* ..... Sport V.4
Spain
Domingo, Placido – *Madrid* ..... Sep 95
Ochoa, Severo – *Luarca* ..... Jan 94
Sanchez Vicario, Arantxa
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2	Asimov, Isaac	1920
3	Tolkien, J.R.R.	1892
4	Naylor, Phyllis Reynolds	1933
	Shula, Don	1930
7	Hurston, Zora Neale	?1891
	Rodriguez, Eloy	1947
8	Hawking, Stephen W.	1942
	Spelman, Lucy	1963
9	McLean, A.J.	1978
	Menchu, Rigoberta	1959
	Nixon, Richard	1913
11	Leopold, Aldo	1887
12	Amanpour, Christiane	1958
	Bezos, Jeff	1964
	Lasseter, John	?1957
	Limbaugh, Rush	1951
13	Webb, Alan	1983
14	Lucid, Shannon	1943
15	Werbach, Adam	1973
16	Aaliyah	1979
	Fossey, Dian	1932
17	Carrey, Jim	1962
	Cormier, Robert	1925
	Jones, James Earl	1931
	Lewis, Shari	?1934
18	Ali, Muhammad	1942
	Messier, Mark	1961
19	Askins, Renee	1959
	Johnson, John	1918
21	Domingo, Placido	1941
	Nicklaus, Jack	1940
	Olajuwon, Hakeem	1963
22	Chavis, Benjamin	1948
	Ward, Lloyd D.	1949
23	Elion, Gertrude	1918
	Thiessen, Tiffani Amber	1974
24	Haddock, Doris (Granny D)	1910
25	Alley, Kirstie	1955
26	Carter, Vince	1977
	Morita, Akio	1921
	Siskel, Gene	1946
	Tarbox, Katie	1982
27	Lester, Julius	1939
28	Carter, Nick	1980
	Fatone, Joey	1977
	Gretzky, Wayne	1961
29	Abbey, Edward	1927
	Gilbert, Sara	1975
	Hasek, Dominik	1965
	Peet, Bill	1915
	Winfrey, Oprah	1954
30	Alexander, Lloyd	1924
	Cheney, Dick	1941
	Engelbart, Douglas	1925
31	Flannery, Sarah	1982
	Robinson, Jackie	1919
	Ryan, Nolan	1947
	Timberlake, Justin	1981

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1	Hughes, Langston	1902
	Spinelli, Jerry	1941
	Yeltsin, Boris	1931
3	Heimlich, Henry	1920
	Nixon, Joan Lowery	1927
	Rockwell, Norman	1894
4	Parks, Rosa	1913
5	Aaron, Hank	1934
6	Leakey, Mary	1913
	Rosa, Emily	1987
	Zmeskal, Kim	1976
7	Brooks, Garth	1962
	Wang, An	1920
	Wilder, Laura Ingalls	1867
8	Grisham, John	1955
9	Love, Susan	1948
10	Konigsburg, E.L.	1930
	Norman, Greg	1955
11	Aniston, Jennifer	1969
	Brandy	1979
	Rowland, Kelly	1981
	Yolen, Jane	1939
12	Blume, Judy	1938
	Kurzweil, Raymond	1948
	Small, David	1945
	Woodson, Jacqueline	?1964

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13	Moss, Randy	1977
15	Groening, Matt	1954
	Jagr, Jaromir	1972
	Van Dyken, Amy	1973
16	Freeman, Cathy	1973
17	Anderson, Marian	1897
	Hargreaves, Alison	1962
	Jordan, Michael	1963
18	Morrison, Toni	1931
19	Tan, Amy	1952
20	Adams, Ansel	1902
	Barkley, Charles	1963
	Cobain, Kurt	1967
	Crawford, Cindy	1966
	Hernandez, Livan	1975
	Littrell, Brian	1975
21	Carpenter, Mary Chapin	1958
	Hewitt, Jennifer Love	1979
	Jordan, Barbara	1936
	Mugabe, Robert	1924
22	Barrymore, Drew	1975
	Fernandez, Lisa	1971
24	Jobs, Steven	1955
	Vernon, Mike	1963
	Whitestone, Heather	1973
25	Voigt, Cynthia	1942
26	Thompson, Jenny	1973
27	Clinton, Chelsea	1980
	Hunter-Gault, Charlayne	1942
28	Andretti, Mario	1940
	Pauling, Linus	1901

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1	Ellison, Ralph Waldo	1914
	Murie, Olaus J.	1889
	Rabin, Yitzhak	1922
	Zamora, Pedro	1972
2	Gorbachev, Mikhail	1931
	Satcher, David	1941
	Seuss, Dr.	1904
3	Hooper, Geoff	1979
	Joyner-Kersee, Jackie	1962
	MacLachlan, Patricia	1938
4	Armstrong, Robb	1962
	Morgan, Garrett	1877
5	Margulis, Lynn	1938
6	Ashley, Maurice	1966
7	McCarty, Oseola	1908
8	Prinze, Freddie Jr.	1976
10	Guy, Jasmine	1964
	Miller, Shannon	1977
	Wolf, Hazel	1898
12	Hamilton, Virginia	1936
	Nye, Naomi Shihab	1952
13	Van Meter, Vicki	1982
14	Dayne, Ron	1977
	Hanson, Taylor	1983
	Williamson, Kevin	1965
15	Ginsburg, Ruth Bader	1933
16	O'Neal, Shaquille	1972
17	Hamm, Mia	1972
	Nureyev, Rudolf	1938
18	Blair, Bonnie	1964
	de Klerk, F.W.	1936
	Griese, Brian	1975
	Queen Latifah	1970
19	Blanchard, Rachel	1976
20	Lee, Spike	1957
	Lowry, Lois	1937
	Sachar, Louis	1954
21	Gilbert, Walter	1932
	O'Donnell, Rosie	1962
22	Shatner, William	1931
24	Manning, Peyton	1976
25	Dragila, Stacy	1971
	Franklin, Aretha	1942
	Lovell, Jim	1928
	Steinem, Gloria	1934
	Swoopes, Sheryl	1971
26	Allen, Marcus	1960
	Erdös, Paul	1913
	O'Connor, Sandra Day	1930
	Stockton, John	1962
27	Carey, Mariah	1970
	Wrede, Patricia C.	1953
28	James, Cheryl	
	McEntire, Reba	1955
	Tompkins, Douglas	1943
29	Capriati, Jennifer	1976
30	Dion, Celine	1968
	Hammer	1933
31	Caplan, Arthur	1950
	Chavez, Cesar	1927
	Gore, Al	1948
	Howe, Gordie	1928

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1	Maathai, Wangari	1940
2	Carvey, Dana	1955

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3	Garth, Jennie	1972
	Goodall, Jane	1934
	Street, Picabo	1971
4	Angelou, Maya	1928
5	Peck, Richard	1934
	Powell, Colin	1937
6	Watson, James D.	1928
7	Douglas, Marjory Stoneman	1890
8	Annan, Kofi	1938
10	Madden, John	1936
12	Cleary, Beverly	1916
	Danes, Claire	1979
	Doherty, Shannen	1971
	Hawk, Tony	1968
	Letterman, David	1947
	Soto, Gary	1952
13	Brandis, Jonathan	1976
	Henry, Marguerite	1902
14	Collins, Francis	1950
	Gellar, Sarah Michelle	1977
	Maddux, Greg	1966
	Rose, Pete	1941
15	Martin, Bernard	1954
16	Abdul-Jabbar, Kareem	1947
	Atwater-Rhodes, Amelia	1984
	Selena	1971
	Williams, Garth	1912
17	Champagne, Larry III	1985
18	Hart, Melissa Joan	1976
20	Brundtland, Gro Harlem	1939
21	Muir, John	1838
22	Levi-Montalcini, Rita	1909
	Oppenheimer, J. Robert	1904
25	Fitzgerald, Ella	1917
26	Giff, Patricia Reilly	1935
	Pei, I.M.	1917
27	Wilson, August	1945
28	Alba, Jessica	1981
	Baker, James	1930
	Duncan, Lois	1934
	Hussein, Saddam	1937
	Kaunda, Kenneth	1924
	Lee, Harper	1926
	Leno, Jay	1950
29	Agassi, Andre	1970
	Earnhardt, Dale	1951
	Seinfeld, Jerry	1954

May		Year
2	Spock, Benjamin	1903
4	Bass, Lance	1979
5	Lionni, Leo	1910
	Maxwell, Jody-Anne	1986
	Opdyke, Irene Gut	1922
	Strasser, Todd	1950
7	Land, Edwin	1909
8	Attenborough, David	1926
9	Bergen, Candice	1946
	Yzerman, Steve	1965
10	Cooney, Caroline B.	1947
	Curtis, Christopher Paul	1953
	Galdikas, Biruté	1946
	Jamison, Judith	1944
	Ochoa, Ellen	1958
11	Farrakhan, Louis	1933
12	Mowat, Farley	1921
13	Pascal, Francine	1938
	Rodman, Dennis	1961
14	Lucas, George	1944
	Smith, Emmitt	1969
15	Albright, Madeleine	1937
	Almond, David	1951
	Johns, Jasper	1930
	Zindel, Paul	1936
16	Coville, Bruce	1950
17	Paulsen, Gary	1939
18	John Paul II	1920
19	Brody, Jane	1941
	Garnett, Kevin	1976
	Hansberry, Lorraine	1930
21	Robinson, Mary	1944
23	Bardeen, John	1908
	Jewel	1974
	O'Dell, Scott	1898
24	Dumars, Joe	1963
26	Hill, Lauryn	1975
	Ride, Sally	1951
27	Carson, Rachel	1907
	Kerr, M.E.	1927
28	Johnston, Lynn	1947
	Shabazz, Betty	1936
30	Cohen, Adam Ezra	1979
?	McGruder, Aaron	1974

June		Year
1	Lalas, Alexi	1970
	Morissette, Alanis	1974
4	Kistler, Darci	1964
	Nelson, Gaylord	1916
5	Scarry, Richard	1919
6	Rylant, Cynthia	1954

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7	Brooks, Gwendolyn	1917
	Oleynik, Larisa	1981
8	Bush, Barbara	1925
	Davenport, Lindsay	1976
	Edelman, Marian Wright	1939
8	Wayans, Keenen Ivory	1958
	Wright, Frank Lloyd	1869
9	Portman, Natalie	1981
10	Frank, Anne	1929
	Lipinski, Tara	1982
	Sendak, Maurice	1928
11	Cousteau, Jacques	1910
	Montana, Joe	1956
12	Bush, George	1924
13	Allen, Tim	1953
	Alvarez, Luis W.	1911
	Christo	1935
14	Bourke-White, Margaret	1904
	Graf, Steffi	1969
	Summitt, Pat	1952
	Yep, Laurence	1948
15	Horner, Jack	1946
	Jacques, Brian	1939
16	McClintock, Barbara	1902
	Shakur, Tupac	1971
17	Gingrich, Newt	1943
	Jansen, Dan	1965
	Williams, Venus	1980
18	Johnson, Angela	1961
	Morris, Nathan	1971
	Van Allsburg, Chris	1949
19	Abdul, Paula	1962
	Aung San Suu Kyi	1945
20	Goodman, John	1952
21	Bhutto, Benazir	1953
	Breathed, Berke	1957
22	Bradley, Ed	1941
	Daly, Carson	1973
	Warner, Kurt	1971
23	Rudolph, Wilma	1940
	Thomas, Clarence	1948
25	Carle, Eric	1929
	Gibbs, Lois	1951
26	Harris, Bernard	1956
	Jeter, Derek	1974
	LeMond, Greg	1961
27	Babbitt, Bruce	1938
	Dunbar, Paul Laurence	1872
	Perot, H. Ross	1930
28	Elway, John	1960
30	Ballard, Robert	1942

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1	Brower, David	1912
	Calderone, Mary S.	1904
	Diana, Princess of Wales	1961
	Duke, David	1950
	Lewis, Carl	1961
	McCully, Emily Arnold	1939
2	Bethe, Hans A.	1906
	Gantos, Jack	1951
	George, Jean Craighead	1919
	Marshall, Thurgood	1908
	Petty, Richard	1937
	Thomas, Dave	1932
5	Watterson, Bill	1958
6	Bush, George W.	1946
	Dalai Lama	1935
	Dumitriu, Ioana	1976
7	Chagall, Marc	1887
	Heinlein, Robert	1907
	Kwan, Michelle	1980
	Sakic, Joe	1969
	Stachowski, Richie	1985
8	Hardaway, Anfernee "Penny"	1971
	Sealfon, Rebecca	1983
9	Farmer, Nancy	1941
	Hanks, Tom	1956
	Hassan II	1929
	Krim, Mathilde	1926
	Sacks, Oliver	1933
10	Ashe, Arthur	1943
	Boulmerka, Hassiba	1969
11	Cisneros, Henry	1947
	White, E.B.	1899
12	Bauer, Joan	1951
	Cosby, Bill	1937
	Johnson, Johanna	1983
	Yamaguchi, Kristi	1972
13	Ford, Harrison	1942
	Stewart, Patrick	1940
15	Aristide, Jean-Bertrand	1953
	Ventura, Jesse	1951
16	Johnson, Jimmy	1943
	Sanders, Barry	1968
18	Glenn, John	1921
	Lemelson, Jerome	1923
	Mandela, Nelson	1918
19	Tarvin, Herbert	1985
20	Hillary, Sir Edmund	1919
21	Chastain, Brandi	1968
	Reno, Janet	1938
	Riley, Dawn	1964
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22	Calder, Alexander	1898
	Dole, Bob	1923
	Hinton, S.E.	1948
23	Haile Selassie	1892
	Williams, Michelle	1980
24	Abzug, Bella	1920
	Krone, Julie	1963
	Lopez, Jennifer	1970
	Moss, Cynthia	1940
	Wilson, Mara	1987
25	Payton, Walter	1954
26	Berenstain, Jan	1923
27	Rodriguez, Alex	1975
28	Davis, Jim	1945
	Pottter, Beatrix	1866
29	Burns, Ken	1953
	Creech, Sharon	1945
	Dole, Elizabeth Hanford	1936
	Jennings, Peter	1938
	Morris, Wanya	1973
30	Hill, Anita	1956
	Moore, Henry	1898
	Schroeder, Pat	1940
31	Cronin, John	1950
	Radcliffe, Daniel	1989
	Reid Banks, Lynne	1929
	Rowling, J. K.	1965
	Weinke, Chris	1972

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1	Brown, Ron	1941
	Coolio	1963
	Garcia, Jerry	1942
2	Baldwin, James	1924
	Healy, Bernadine	1944
3	Roper, Dee Dee	
	Savimbi, Jonas	1934
4	Gordon, Jeff	1971
5	Ewing, Patrick	1962
	Jackson, Shirley Ann	1946
6	Cooney, Barbara	1917
	Robinson, David	1965
	Warhol, Andy	?1928
7	Byars, Betsy	1928
	Duchovny, David	1960
	Leakey, Louis	1903
	Villa-Komaroff, Lydia	1947
8	Boyd, Candy Dawson	1946
	Chasez, JC	1976
9	Anderson, Gillian	1968
	Holdsclaw, Chamique	1977
	Houston, Whitney	1963
	McKissack, Patricia C.	1944
	Sanders, Deion	1967
	Travers, P.L.	?1899
11	Haley, Alex	1921
	Hogan, Hulk	1953
	Rowan, Carl T.	1925
	Wozniak, Steve	1950
12	Barton, Hazel	1971
	Martin, Ann M.	1955
	McKissack, Fredrick L.	1939
	Myers, Walter Dean	1937
	Sampras, Pete	1971
13	Battle, Kathleen	1948
	Castro, Fidel	1927
14	Berry, Halle	?1967
	Johnson, Magic	1959
	Larson, Gary	1950
15	Affleck, Benjamin	1972
	Ellerbee, Linda	1944
16	Fu Mingxia	1978
	Thampy, George	1987
18	Danziger, Paula	1944
	Murie, Margaret	1902
19	Clinton, Bill	1946
	Soren, Tabitha	1967
20	Chung, Connie	1946
	Milosevic, Slobodan	1941
21	Chamberlain, Wilt	1936
	Draper, Sharon	1952
	Toro, Natalia	1984
22	Bradbury, Ray	1920
	Dorough, Howie	1973
	Schwarzkopf, H. Norman	1934
23	Bryant, Kobe	1978
	Novello, Antonia	1944
	Phoenix, River	1970
24	Arafat, Yasir	1929
	Dai Qing	1941
	Ripken, Cal, Jr.	1960
25	Case, Steve	1958
26	Burke, Christopher	1965
	Culkin, Macaulay	1980
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	Tuttle, Merlin	1941
27	Nechita, Alexandra	1985
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28	Dove, Rita	1952
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	Peterson, Roger Tory	1908
	Priestley, Jason	1969
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	Twain, Shania	1965
29	Grandin, Temple	1947
	Hesse, Karen	1952
	McCain, John	1936
30	Earle, Sylvia	1935
31	Perlman, Itzhak	1945

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1	Estefan, Gloria	1958
	Guy, Rosa	1925
	Smyers, Karen	1961
2	Bearden, Romare	?1912
	Galeczka, Chris	1981
	Lisanti, Mariangela	1983
	Mohajer, Dineh	1972
3	Delany, Bessie	1891
4	Knowles, Beyoncé	1981
	Wright, Richard	1908
5	Guisewite, Cathy	1950
6	Fiorina, Carly	1954
7	Lawrence, Jacob	1917
	Moses, Grandma	1860
	Pippig, Uta	1965
	Scurry, Briana	1971
8	Prelutsky, Jack	1940
	Scieszka, Jon	1954
	Thomas, Jonathan Taylor	1982
10	Gould, Stephen Jay	1941
13	Johnson, Michael	1967
	Monroe, Bill	1911
	Taylor, Mildred D.	1943
14	Armstrong, William H.	1914
	Stanford, John	1938
15	dePaola, Tomie	1934
	Marino, Dan	1961
16	Dahl, Roald	1916
	Gates, Henry Louis, Jr.	1950
17	Burger, Warren	1907
18	Armstrong, Lance	1971
	Carson, Ben	1951
	de Mille, Agnes	1905
	Fields, Debbi	1956
19	Delany, Sadie	1889
21	Fielder, Cecil	1963
	Hill, Faith	1967
	King, Stephen	1947
	Nkrumah, Kwame	1909
22	Richardson, Dot	1961
23	Nevelson, Louise	1899
24	George, Eddie	1973
	Ochoa, Severo	1905
25	Gwaltney, John Langston	1928
	Locklear, Heather	1961
	Lopez, Charlotte	1976
	Pinkney, Andrea Davis	1963
	Pippen, Scottie	1965
	Reeve, Christopher	1952
	Smith, Will	1968
	Walters, Barbara	1931
26	Mandela, Winnie	1934
	Stockman, Shawn	1972
	Williams, Serena	1981
27	Handford, Martin	1956
28	Cray, Seymour	1925
	Pak, Se Ri	1977
29	Berenstain, Stan	1923
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	Gumbel, Bryant	1948
30	Hingis, Martina	1980
	Moceanu, Dominique	1981

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1	Carter, Jimmy	1924
	McGwire, Mark	1963
2	Leibovitz, Annie	1949
3	Campbell, Neve	1973
	Herriot, James	1916
	Richardson, Kevin	1972
	Winfield, Dave	1951
4	Cushman, Karen	1941
	Kamler, Kenneth	1947
	Rice, Anne	1941
5	Fitzhugh, Louise	1928
	Hill, Grant	1972
	Lemieux, Mario	1965
	Lin, Maya	1959
	Winslet, Kate	1975
6	Bennett, Cherie	1960
	Lobo, Rebecca	1973
7	Ma, Yo-Yo	1955
8	Jackson, Jesse	1941
	Ringgold, Faith	1930
	Stine, R.L.	1943
	Winans, CeCe	1964
9	Bryan, Zachery Ty	1981
	Senghor, Léopold Sédar	1906
	Sorenstam, Annika	1970

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10	Favre, Brett	1969
	Saro-Wiwa, Ken	1941
11	Perry, Luke	?1964
	Young, Steve	1961
12	Childress, Alice	?1920
	Jones, Marion	1975
	Ward, Charlie	1970
13	Carter, Chris	1956
	Kerrigan, Nancy	1969
	Rice, Jerry	1962
14	Daniel, Beth	1956
	Mobutu Sese Seko	1930
15	Iacocca, Lee A.	1924
16	Stewart, Kordell	1972
17	Jemison, Mae	1956
	Kirkpatrick, Chris	1971
18	Foreman, Dave	1946
	Marsalis, Wynton	1961
	Navratilova, Martina	1956
	Suzuki, Shinichi	1898
19	Pullman, Philip	1946
20	Kenyatta, Jomo	?1891
	Mantle, Mickey	1931
	Pinsky, Robert	1940
21	Gillespie, Dizzy	1956
	Le Guin, Ursula K.	1929
22	Hanson, Zac	1985
23	Crichton, Michael	1942
	Pelé	1940
25	Martinez, Pedro	1971
26	Clinton, Hillary Rodham	1947
27	Anderson, Terry	1947
28	Gates, Bill	1955
	Roberts, Julia	1967
	Salk, Jonas	1914
29	Ryder, Winona	1971
31	Candy, John	1950
	Paterson, Katherine	1932
	Pauley, Jane	1950
	Tucker, Chris	1973

November		Year
2	lang, k.d.	1961
3	Arnold, Roseanne	1952
	Ho, David	1952
	Kiraly, Karch	1960
4	Combs, Sean (Puff Daddy)	1969
	Handler, Ruth	1916
7	Canady, Alexa	1950
8	Mittermeier, Russell A.	1949
9	Denton, Sandi	
	Sagan, Carl	1934
10	Bates, Daisy	?1914
11	DiCaprio, Leonardo	1974
	Vonnegut, Kurt	1922
12	Andrews, Ned	1980
	Blackmun, Harry	1908
	Harding, Tonya	1970
	Sosa, Sammy	1968
13	Goldberg, Whoopi	1949
14	Boutros-Ghali, Boutros	1922
	Hussein, King	1935
15	O'Keeffe, Georgia	1887
	Pinkwater, Daniel	1941
16	Baiul, Oksana	1977
	Miyamoto, Shigeru	1952
17	Fuentes, Daisy	1966
	Hanson, Ike	1980
18	Driscoll, Jean	1966
	Mankiller, Wilma	1945
19	Collins, Eileen	1956
	Devers, Gail	1966
	Glover, Savion	1973
	Strug, Kerri	1977
21	Aikman, Troy	1966
	Griffey, Ken, Jr.	1969
	Speare, Elizabeth George	1908
24	Ndeti, Cosmas	1971
25	Grant, Amy	1960
	Thomas, Lewis	1913
26	Patrick, Ruth	1907
	Pine, Elizabeth Michele	1975
	Schulz, Charles	1922
27	Nye, Bill	1955
	White, Jaleel	1977
29	L'Engle, Madeleine	1918
	Lewis, C. S.	1898
	Tubman, William V. S.	1895
30	Jackson, Bo	1962
	Parks, Gordon	1912

December		Year
2	Macaulay, David	1946
	Seles, Monica	1973
	Spears, Britney	1981
	Watson, Paul	1950
3	Kim Dae-jung	?1925
	Filipovic, Zlata	1980
5	Muniz, Frankie	1985
6	Risca, Viviana	1982

December (continued)		Year
7	Bird, Larry	1956
8	Rivera, Diego	1886
9	Hopper, Grace Murray	1906
12	Bialik, Mayim	1975
	Frankenthaler, Helen	1928
	Sinatra, Frank	1915
13	Fedorov, Sergei	1969
14	Jackson, Shirley	1916
15	Aidid, Mohammed Farah	1934
	Mendes, Chico	1944
16	Bailey, Donovan	1967
	McCary, Michael	1971
	Mead, Margaret	1901
17	Kielburger, Craig	1982
18	Aguilera, Christina	1980
	Holmes, Katie	1978
	Pitt, Brad	1964
	Sanchez Vicario, Arantxa	1971
	Spielberg, Steven	1947
19	Morrison, Sam	1936
	Sapp, Warren	1972
	White, Reggie	1961
20	Uchida, Mitsuko	1948
	Zirkle, Aliy	1969
21	Evert, Chris	1954
	Griffith Joyner, Florence	1959
	Stiles, Jackie	1978
	Webb, Karrie	1974
22	Pinkney, Jerry	1939
23	Avi	1937
	Harbaugh, Jim	1963
	Lowman, Meg	1953
24	Lowe, Alex	1958
	Martin, Ricky	1971
25	Sadat, Anwar	1918
26	Butcher, Susan	1954
27	Roberts, Cokie	1943
28	Lee, Stan	1922
	Washington, Denzel	1954
30	Woods, Tiger	1975

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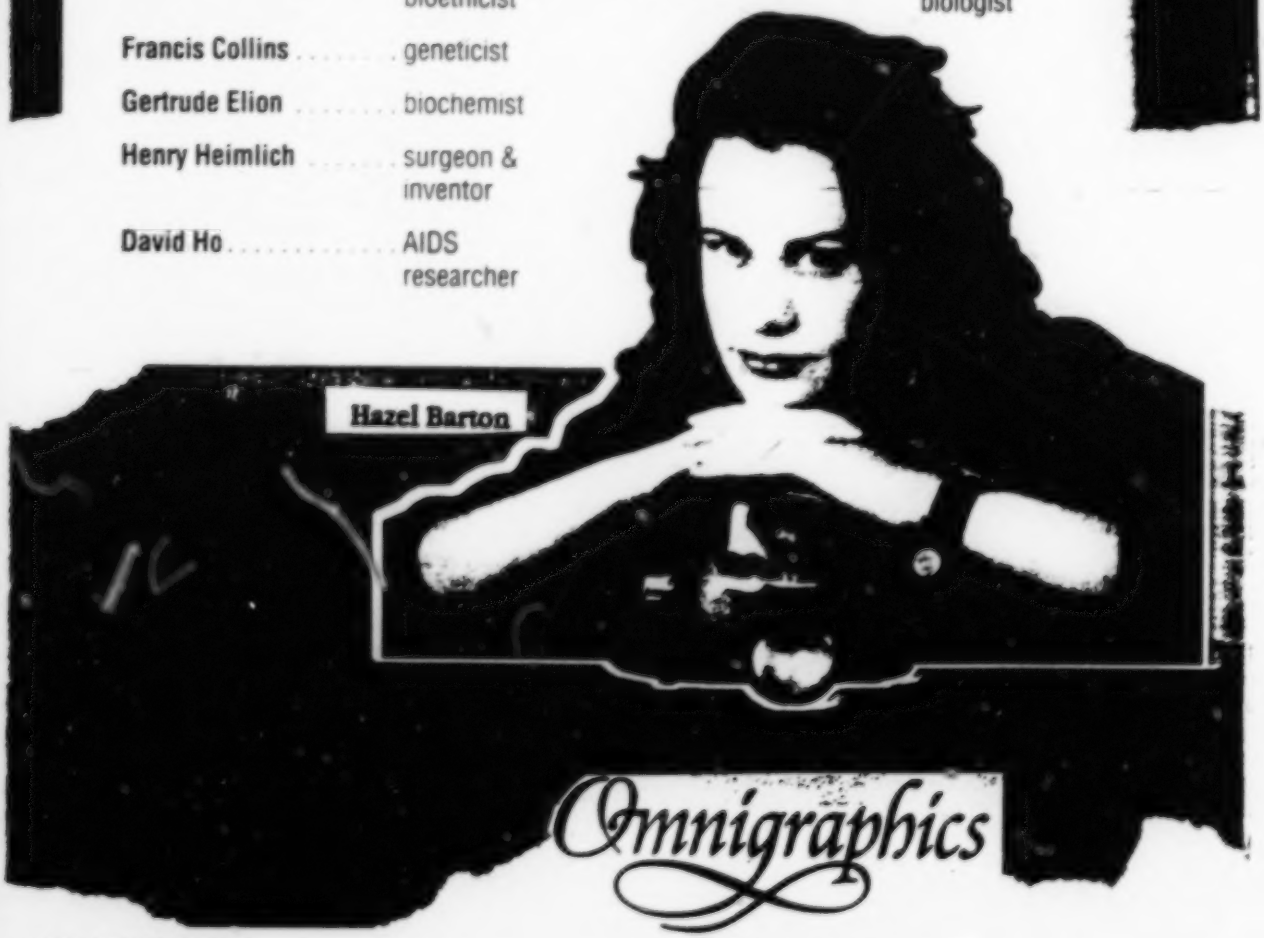

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